Project Portfolio Management Best Practice and Implementation: A South African perspective

by
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DECLARATION

By submitting this thesis electronically, I declare that the entirety of the work contained therein is my own, original work, that I am sole author thereof (save to the extent explicitly otherwise stated), that reproduction and publication thereof by Stellenbosch University will not infringe any third party rights and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

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ABSTRACT

Organizations are constantly under pressure to innovate and grow by successfully executing their business strategies. The ever-increasing rate of change in technology has implications for product lifecycles, cost pressures, expectations of higher quality and a larger variety of products and services. These trends result in mounting pressures and a huge increase in complexity, as the drivers of innovation must be managed to achieve a competitive advantage. Project Portfolio Management (PPM) is a solution for managing the complexities of multi-projects, and is theorized to assist an organization in achieving this competitive advantage through the implementation of business strategy, balancing portfolios, maximizing value, and ensuring resource adequacy. There is however, a lack of empirical evidence regarding the employment and success of PPM approaches in South Africa. This study presents and validates a framework, and it analyses the link between PPM implementation and PPM success in achieving strategic objectives. The framework is constructed from a thorough literature review regarding the factors of good practice in PPM.

This thesis identifies and investigates three areas of PPM literature: (1) success criteria (2) success factors and (3) challenges in PPM. To address the lack of empirical research in this field for the South African context, the framework and identified areas of literature were empirically tested. This was done using a mixed methodology approach consisting of two stages: (1) quantitative (surveys) and (2) qualitative (interviews). The quantitative results from the surveys were based on 342 respondents, yielding a response rate of 17%. The data from the surveys were analysed and followed by 4 interviews to gain better insight and understanding into the results of the surveys.

This study contributes to the investigation of the relationship between the best practices of project portfolio management as well as its success. This study creates a solid platform upon which future studies in the field of project portfolio management can be built.

OPSOMMING

Maatskappye is alewig onder druk om te innoveer en groei deur die besigheid se strategie suksesvol uit te voer. Met die konstante veranderinge in tegnologie is daar implikasies vir die maatskappy in die vorm van produkte se lewensiklusse, koste, verwagtinge van hoër kwaliteit en groter verskeidenheid produkte en dienste. Die tendense veroorsaak druk en 'n styging van kompleksiteit om 'n kompeterende voordeel te behaal. Portefeulje projekbestuur is 'n oplossing om die kompleksiteit van multi-projekte te ontrafel en om 'n maatskappy te help om die besigheidstrategie te implementeer, die portefeulje te balanseer, maksimum waarde te behaal, as ook seker te maak daar is genoeg hulpbronne. Daar is 'n tekort aan empiriese werk oor die gebruik en sukses van portefeulje projek bestuur in Suid Afrika. Hierdie studie ontwikkel en toets die geldigheid van 'n raamwerk, en dit ontleed die verhouding tussen portefeulje projekbestuurimplementering en maatskappy sukses faktore. Die raamwerk is gebaseer op 'n deeglike literatuurstudie.

Die tesis identifiseer en ondersoek drie areas van portefeulje projekbestuurimplementering literatuur: (1) sukses kriteria, (2) sukses faktore, en (3) uitdagings in portefeulje projekbestuurimplementering. Om die tekort van empiriese navorsing aan te spreek in die veld vir die Suid Afrikaanse konteks, word die raamwerk empiries getoets. Hierdie was gedoen deur 'n gemengde metode benadering te gebruik, die het twee stadiums gehad: (1) kwantitatiewe (meningsopname) en (2) kwalitatiewe (onderhoude). Die kwantitatiewe resultate van die meningsopname was gebaseer op 342 respondente, wat 'n 17% responskoers gee. Die data van die meningsopname was ontleed en op gevolg met 4 onderhoude om beter insig en perspektief van die meningsopname resultate te kry.

Die belangrikste bydra van die studie is die empiriese ondersoek in die verhouding tussen die beste praktyke van portefeulje projek bestuur en hul sukses. Hierdie studie skep 'n sterk platform waarop toekomstige studies, in die veld van portefeulje projek bestuur, gebaseer kan word.

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You are my role models and I'm so blessed to be your daughter; I would choose you both a million times over! Thank you for your unconditional love and support. You truly live by example!

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LIST OF ACRONYMS AND ABBREVIATIONS

CFA	Conceptual Framework Analysis
CSF	Critical Success Factor
KPIs	Key Performance Indicators
MPT	Modern Portfolio Theory
MSP	Managing Successful Programmes
NPD	New Product Development
PM	Project Management
PMBoK	Project Management Body of Knowledge
PMI	Project Management Institute
PMO	Project Management Office
PMP	Project Manager Professional
PPM	Project Portfolio Management
PPMO	Project Portfolio Management Office
PPP	Project Programme Portfolio
R&D	Research and Development
SAIIE	South African Institute for Industrial Engineering
SAJIE	South African Journal for Industrial Engineering

CHAPTER 1 - INTRODUCTION AND PROBLEM STATEMENT

Organizations are constantly under pressure to innovate and grow by successfully executing their business strategies. This could become complex and challenging for organizations in the ever-changing environments. Organizations need efficient implementation of their desired strategy. However, in many organizations a gap exists between the development of strategy and its successful implementation (Buys and Stander, 2012; Dietrich and Lehtonen, 2005; Meskendahl, 2010; Hrebiniak, 2006). In 1998 Grundy stated that implementation phase is frequently the graveyard of strategy, and it remains a neglected area in research; more recent literature has agreed with this statement (Buys and Stander, 2012; Dietrich and Lehtonen, 2005).

Patton and White (2002) find that closing the integration gaps between an organization's strategic plan and its implementation is essential for achieving and sustaining a competitive advantage. It has been proposed that the solution could lie in making use of project portfolio management (PPM) (e.g. Dietrich and Lehtonen, 2005; Grundy, 2000; Müller et al., 2008). Project portfolio management (PPM) has increasingly become recognized as an area of practice that ensures effective strategy implementation.

Dawidson (2006) states that portfolio management encompasses more than evaluation techniques, and it includes a more comprehensive managerial approach; not only focusing on techniques, tools, and methods, but also to include aspects on how PPM is practised. Consequently, the multifaceted goals and benefits of portfolios must be established before the selection of any projects can take place to meet the organization's overall objectives (Meskendahl, 2010). Corporate strategy is typically created at a top management level, then filtered down to the portfolio level, and finally to the project level (Archer and Ghasemzadeh, 1999).

The coordinated management of projects and portfolios benefits the organization (Platje et al., 1994). Some literature has been dedicated to highlight portfolio management's importance to evaluate, prioritize, and select projects in line with the organization's strategy (e.g. Cooper et al., 2001; Blichfeldt and Eskorod, 2008; Enguld and Graham, 1999; Archer and Ghasemzadeh, 2004). PPM is growing in importance for organizations to compete in a global dynamic environment, where organizational survival depends on a steady stream of successful new products (Killen et al., 2008). Effectively implementing organizational strategy through a portfolio of projects, and thus enhancing the long-term value of the portfolio, are the primary goals of PPM (Killen, 2015).

Although PPM has been well researched (Archer and Ghasemzadeg, 1999; Cooper, Edgett and Kleinschmidt, 1997; Dye and Pennypacker, 1999, 2002; Artto and Dietrich 2004; Kaiser et al., 2015; Killen et al., 2008), there is still a lack of empirical evidence in the literature, on achieving success through the implementation of PPM factors of best practice, especially in the South African environment (Dietrich and Lehtonen, 2005; Müller et al., 2008; Buys and Stander, 2012).

> *'However, current literature lacks empirical evidence of the levels of employment, functionality, and success of the Project Portfolio Management approach in South Africa.'*- (Buys and Stander, 2012)

Organizations also face problems when it comes to the implementation of PPM practices such as the following: (1) project level activities, (2) portfolio level activities, (3) portfolio competencies and methods, (4) the link to strategy, (5) resources management, and (6) information management.

This thesis investigates PPM as a possible solution to the management problems, by determining to what extent PPM practices are perceived to be employed by South African organizations. The objective is to identify the factors and correlating them with the success in managing strategic intention through project portfolios. This thesis also investigates the problems faced by management and possible solutions to these problems.

The aim is to address the lack of empirical evidence on PPM in the South African context, by deductively constructing a framework from literature and testing the theories. This thesis constructs a framework on previous PPM research, to broaden the understanding of the relationship between best PPM practices and achieving PPM success. This leads up to the question: **Which factors influence the success of a PPM, and how often are these practices used?**

This research study focuses on the implementation of strategy by using Project Portfolio Management (PPM). This chapter is an introduction to the thesis, allowing the reader to be familiarized with the research of study and gain an overview of the research layout. The background, with clear Project Portfolio Management challenges is introduced, followed by the objectives derived from the gap in literature. Limitations and delimitations are stated, followed by the research methodology, ethical implications and finally the outline of the document.

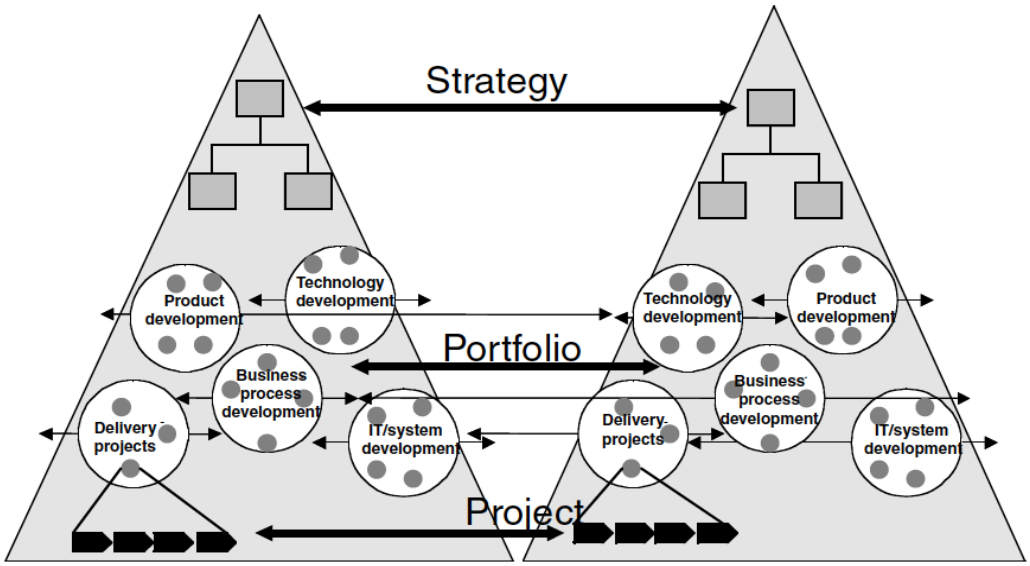
1.1. BACKGROUND

Harry Markowitz increased the awareness of portfolio management with his paper in 1952 on the Modern Portfolio Theory (MPT). This theory determines the highest return on a specific mix of investments for a given level of risk. MPT was initially developed for financial investments, but in 1981 McFarlan adapted the theory to the modern field of PPM for IT projects. McFarlan noted that should a company not employ a risk-based approach to IT portfolio selection, gaps could be left for competitors to step in.

Portfolio management is a coordinated management practice of one or more portfolios that aims to achieve the organization's strategic objectives. It is ultimately an executable plan of linking the projects, programmes, and portfolios to the organizational strategy. Since organizations execute their strategies through the creation of strategic initiatives comprised of programs and project portfolios, they in turn must become vehicles for executing the organization's strategy (Cabanis-Brewin and Pennypacker, 2006).

Driven by the ever-quickening rate of change in industries, organizations are increasingly becoming more projects based and therefore they are focusing more on effective project management (Killen et al., 2008). There are different theories regarding the relationship between portfolio management practices and their performance. Cooper, Edgett, and Kleinschmidt (1997, 1999, and 2000) have shown that certain types of project, process, and portfolio practices are more typical to high-performing firms than low-performing firms. Loch (2000), however, arrived at the conclusion that there is no 'best practice' for a new product development (NPD) process. A company should rather customize its project portfolio to correspond to all the different processes and the strategic innovation needs.

Managerial perspective has changed from focusing on one project, towards simultaneously managing a whole collection of projects as one large entity. Morgan et al. (2007) state that strategic transformation can only be accomplished when senior management engage deeply in project management. Portfolios of different project types are typically arranged under the governance of organizational units or responsibility areas as seen in the Figure 1 below.



Source: Artto et al. (2002).

Figure 1: Two companies (or two business units) with networked projects and portfolios (Artto et al., 2002).

Managerial processes that are above projects, must link projects to business goals and the expectations set by the company strategy. According to PMI (2008), multiple project

management (MPM) refers to the organizational-level environment with which projects are managed concurrently. This refers to projects that vary in size and importance as well as life cycle phases, and they may not necessarily be co-dependent or directly related. Program management is a centralized and coordinated approach that manages goal related projects to achieve the program's strategic objectives (PMI, 2008). This study takes the stance that success, from a strategic perspective, is dependent on the organization's ability to implement the desired process or action.

It is important to understand that the complexity and maturity levels of every organization differ, and the way in which decisions are made must be adjusted accordingly. It is also essential for each company to design a portfolio planning process to fit the nature of its business and to compliment the relationships the firm typically maintains with its customers, key vendors, and strategic partners (Patterson, 2005).

1.2. RESEARCH AIM

The aim of this research is to *empirically investigate the link between the implementation of various project portfolio management practices and the perceived success of project portfolios within a South African context in order to derive at recommendations for project portfolio management at South African companies.*

1.3. OBJECTIVES

To achieve the aim of this study, eight main objectives were developed. These objectives lead the study into the intended direction to maintain focus on the aim of this thesis. The objectives are the following:

(1) Critically review definitions of strategy and how strategy and PPM are interrelated.
(2) Critically review and analyse existing theory, tools, and frameworks of PPM.
(3) Critically review and analyse the empirical literature on PPM.
(4) Critically review and analyse literature for the definition of PPM success criteria.
(5) Construct a conceptual framework of the best practices of PPM, based on literature.

(6) Perform an empirical study evaluating the implementation of PPM practices, the link between the implementation of PPM practices and perceived PPM success and the perceived link between PPM practices and PPM success.
(7) Review the results from the empirical study and investigate arising uncertainties through further qualitative analysis.
(8) Synthesise the results obtained throughout the study to derive recommendations for PPM practice in South Africa

The objectives were addressed through the research questions in each chapter. Table 1 below shows how each chapter as well as the unique questions were aimed to achieve the eight main objectives.

Table 1: the document outline – questions answered in each section

HEADING	QUESTIONS FOR EACH CHAPTER	Objective
CHAPTER 2 - Methodology	• What methodologies were previously used in PPM and framework construction literature? • What is the nature of this study? • What are the proposed steps taken by the chosen methodology? • What are the steps that this study took to construct the framework?	5
CHAPTER 3 - Literature Review	Strategy • What is strategy and why is it important to the organization? • What are the different levels of strategy? • What is strategic innovation? • How is PPM linked to the questions above? • What are the different management types and how do they fit into the levels of strategy?	1
	PPM • What is the definition of PPM? • What benefits can be expected when incorporating PPM practices? • What are the complexities and assumptions that are made with PPM? • According to literature, what are the challenges faced by portfolio managers? • Which tools are used for PPM? • What are the different types of frameworks used for PPM?	2 & 3
	Success • What are a project's success criteria and factors? • What are the different PPM success criteria in literature? • Which are the six mostly used or mentioned PPM success criteria according to literature? • What are the PPM factor categories chosen for this study? • What are the factors of best practice for PPM?	4
CHAPTER 4 – Framework	• Which authors have contributed to the development of the framework? • How was the framework validated? • Were there any adjustments made to the framework?	5 & 3
CHAPTER 5 – Methodology for evaluating the conceptual framework elements	• What is validity and how was it approached in this study? • What is a mixed method approach? • What was the target population for the surveys and interviews? • What data collection methods were researched and used? • What were the initial steps to validate the survey and interview? • How was the data collection performed?	6 & 7

	• What methods were used to analyse the data collected?	
CHAPTER 6 – Results	Surveys • How do different industries rate each success criteria? • How do the different success criteria correlate with the perceived success of different industries? • How do the different management levels rank the success criteria? • How do the different success criteria correlate with the perceived success of the different levels of management? • How do the perception of practices' influence and the uses of practices differ, according to different industries? • How do the perception of practices' influence and the uses of practices differ, according to different management levels? • How do the uses of practices correlate to the portfolio success? • What are the problems faced by the different industries? • What are the problems faced by the different management levels? • How do the problems faced by the organizations with PPM differ from the problems faced without PPM?	6
	Interviews • Industries rated portfolio balance as one of the lower success criteria, yet overall it has the strongest correlation. Why do you think this is? • Although single-project success is ranked the highest, the correlation to portfolio management success is the lowest. What underlying dynamics may cause this? (Refer to Table 41 and Table 42) • The 'perception' is that practices of Project Information have great influence on the success of Portfolio Management, yet the practices are reported not to have been often in 'use'. Why is this and how could organizations improve this? (Refer to Table 41 and Table 42) • The organizations with portfolio managers face fewer problems, according to the means taken from the six problem areas. The 'perception' and 'use' of multi-project level (portfolio level) practices is low compared to the other practices, yet they do have good correlations with the portfolio success. Why is there such a gap in the 'use' and 'perception' of portfolio management practices? • All the industries struggle with allocating resources effectively. Why is this a major problem and what can be done to solve it? (Refer to **Error! Not a valid result for table.**) • There seems to be a difference between top and middle management's rating for the problems identified in this study. What could be the explanation for this? • (Refer to Table 7) • The results show that organizations with a portfolio manager rate the problems (identified in this study) lower than those organizations without a portfolio manager (refer to Table 50). What are the major benefits a portfolio manager can bring to an organization?	7
	Recommendations • What were the main uncertainties from the data findings and how did the interviewees address these uncertainties? • What recommendations can be made to improve on these uncertainties?	8

1.4. RESEARCH METHODOLOGY

According to Collis and Hessey (2003), the purpose of research is to contribute to the existing body of knowledge. This can be done through the review of established theories and/or the creation of new ones, that would further improve the understanding of a new phenomenon and present possible solutions to problems. Research is a systematic process that requires a variety of considerations in the presentation and interpretation of data. The approach to this research will consist of broad literature that covers the relevant questions and studies done around this study's focus.

Project management and project portfolio management is a relatively young discipline, and the research approaches are also in the process of transition (Killen et al., 2012). Past approaches have employed multiple case studies, in-depth interviewing, developing conceptual models, observation, and analysis (Turner, 2010). However, most project management and project portfolio management research remain largely theoretical (Killen et al., 2012).

This thesis aims to develop and test a conceptual framework that will explore the link between PPM related factors and practices, as well as achieving PPM success. To achieve this aim, this study follows a qualitative methodology similar to that which Jabareen (2009) proposed to develop a conceptual framework, as well as a mixed methodological approach to verify the conceptual framework. A mixed method study combines qualitative and quantitative approaches into a multi- or single-phased study (Cotton et al., 1998).

Jabareen (2009) proposed a process, of eight phases to develop and evaluate the conceptual framework. These phases form the basis for the framework development process followed in this study as shown in Table 2, summarizing the objectives, actions taken, and location of each phase in this thesis. Figure 2 also provides a visual representation of the process.

Table 2: Process followed in this study to create and validate the conceptual framework.

Phase	Objective of phase	What was done	Where in the study performed
Phase 1: Mapping the selected data sources	Identify PPM literature	A list of 183 sources were used to do a systematic review	Foundation for Chapter 2
Phase 2: Extensive reading and categorizing of the selected data	Identify data categories	Studies were coded by identifying key words and using Atlas.ti	
Phase 3: Identifying and naming concepts	Develop concepts from extensive reading of literature		
Phase 4: Deconstructing and categorizing the concepts	Identify main attributes, characteristics, assumptions and roles of each concept	Objectives, PPM challenges, and assessment tools for PPM identified	Chapter 2 - Project Portfolio Management Practices - Objectives - Challenges - Tools and Frameworks
Phase 5: Integrating concepts	Group similar concepts	Success factors and success criteria were defined	Chapter 2 - Success Factors - Success Criteria
Phase 6: Synthesis and resynthesizes	Develop a conceptual framework	Concepts were divided into the four factor categories to create the conceptual framework	Chapter 2 & 3 - Success Factors - Steps explained for conceptual framework development
Phase 7: Validating the conceptual framework	Validate the conceptual framework through feedback	The framework was presented in an article and sent to the SAJIE; this was accepted for publication	Chapter 4 - Summary of authors, - Framework validation
Phase 8: Rethinking the conceptual framework	Identify lessons learnt from conceptual framework	The feedback from the reviewers were taken and adjusted accordingly	Chapter 4 - Framework validation

1.4.1 PROPOSED RESEARCH STRATEGY

This thesis critically investigates the relationship between the PPM practices and PPM success. The aim of this study is to ultimately test the conceptual framework that evolved from the literature review. The research strategy needs to be planned with the intention to achieve the main research aim. Figure 2 below illustrates the process of constructing the framework and how the framework was tested. The data was collected through a structured survey for targeted management teams in South African organizations and then followed up by interviews.

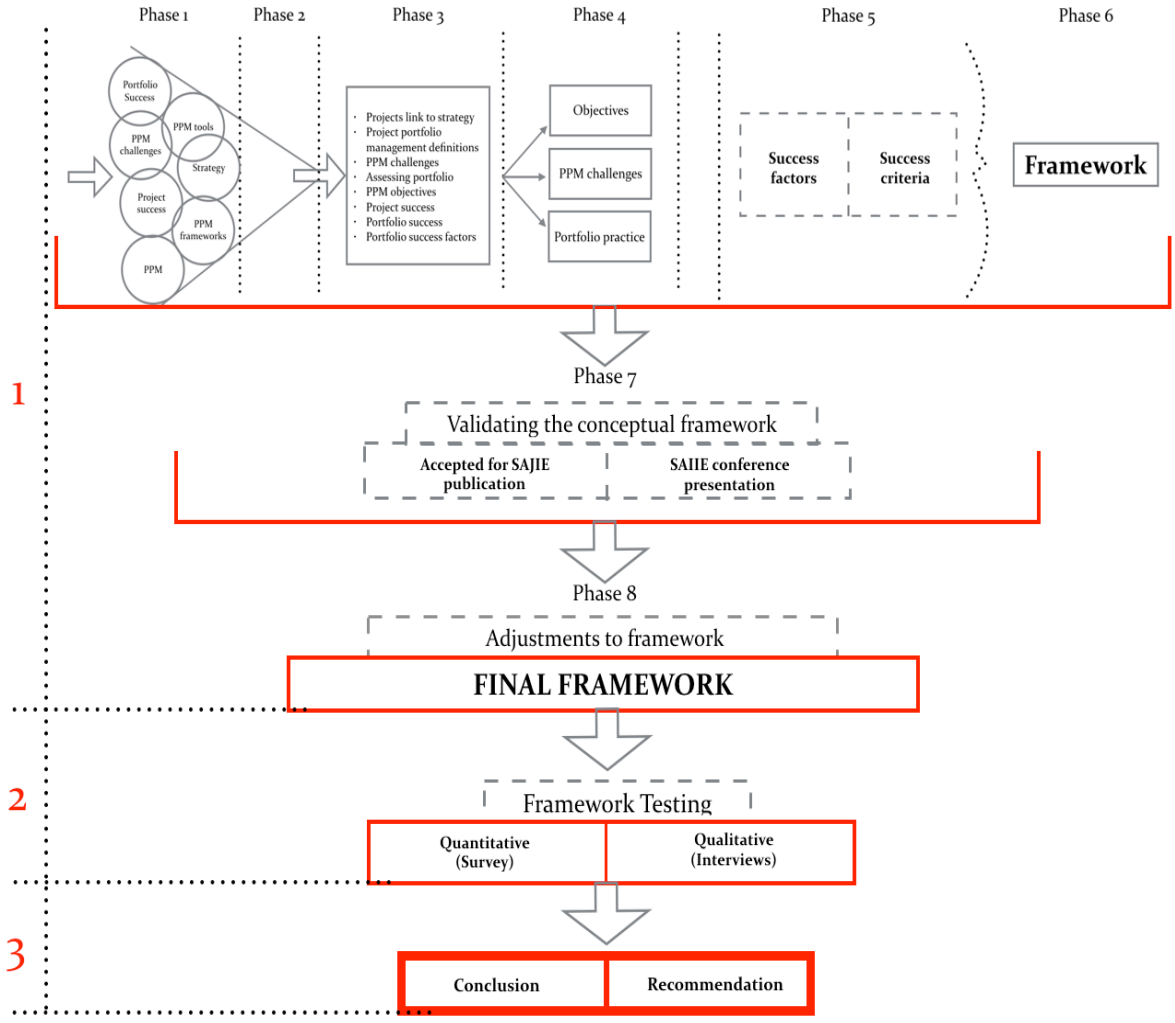


Figure 2: Three main stages of this study

1.4.2 RESEARCH APPROACH

As seen in Figure 2, this research study is divided into three sections:

(1) The literature study that builds a framework (Table 3);

(2) Data collection and results (Table 4); and lastly

(3) The conclusion and recommendations.

Literature Study

The first section was covered in Chapters 2, 3, and 4. Chapter 2 explains the development of the framework, Chapter 3 describes the literature that the framework is based on, and Chapter 4 indicates the framework itself. There are various resources that will be used in this study: articles, books, blogs, papers, interviews, surveys, theses, journals, and any relevant findings. The literature study will consist of three main subjects that construct the conceptual framework. Table 3 below describes the subjects in more detail

Table 3: A description of each category within the literature study and the contribution to the study

SUBJECT	OUTLINE	CONTRIBUTION TO STUDY
Overview of strategy and how PPM is linked to strategy	• Defining strategy • Common strategic perspectives • Strategic innovation • Connection between strategy and PPM • Levels of management	• Contributes to the survey by giving an understanding of the importance of PPM in strategy • Identifies the target audience for survey and interviews
Overview of PPM practices and the strategic intent in literature	• Defining PPM • Challenges of PPM • Project and portfolio assessment tools, techniques, methods, and models • Frameworks for PPM and selection	• Contribution to survey by creating a foundation to identify the factors that influences the success • Contributes to the survey by identifying PPM challenges
Identifying and defining PPM success factors and criteria	• Identifies project success • Identifies PPM success criteria • Identifies PPM success factors	• Contribution to the survey • Measurements of success/success criteria • PPM success factors and related authors

Data Collection and Analysing Results

With enough information gathered on the study of focus, a survey was constructed to determine the correlation between the success of a portfolio and the perceived use of the practice (factors). This section was covered in Chapters 5 and 6. Chapter 5 explained step by step how the surveys and interviews were set up, and Chapter 6 presented the results from the surveys and interviews. The main categories in this section are explained in the Table 4 below:

Table 4: A description of each category within the data collection and analysis section, and their contribution to the study

CATEGORY	OUTLINE	CONTRIBUTION TO STUDY
Correlation studies/data gathering methodologies	• How to perform a correlation study • Advantages and disadvantages of a correlation study	• Understanding how results should be interpreted
Questionnaire construction	• Questions are constructed through the support of literature • Comparing theory to practice	• Contribute validation and findings of study
Survey	• Questionnaires are sent to organizations in South Africa • Management involved in strategy and PPM are specifically targeted	• The more expert advice and experience contributing to this study, the better for the validation
Analysing feedback	• Correlation factors and the significance of the correlations	• Identify which factors are important and which have no correlation to success
Interviews	• Construct an interview with the results from the surveys • Conduct the interviews with selected participants	• Unravel the results of the correlation study • Explain those results

Conclusion and Recommendation

The final section was covered in Chapter 7 and consists of a conclusion about the thesis and the findings, followed by a recommendation for future studies.

1.5. ETHICAL IMPLICATIONS OF RESEARCH

According to the knowledge of the author no ethical implications are expected during or as a result of this study and the rules and regulations set out by Stellenbosch University are carried out. The Research Development Division at the University of Stellenbosch gave ethical clearance this study.

CHAPTER 2 – STUDY METHODOLOGY

The literature study from Chapter 1 states a need for empirical evidence on the employment and success of PPM, with focus on South Africa. This chapter explains the process of the framework development. The framework is presented in Chapter 4, after the literature study in Chapter 3. Figure 3 presents the layout of this chapter. Each section of this chapter is linked to a specific guiding question as shown in Table 5.

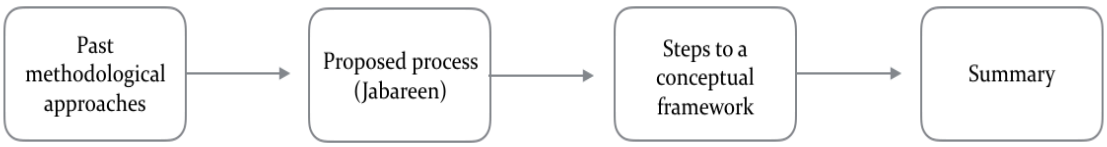
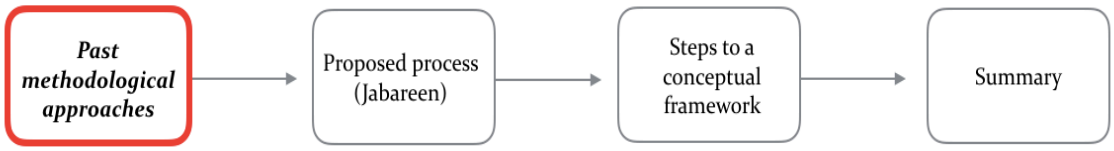


Figure 3: Steps followed in the methodology section.

Table 5: The main questions and where it is addressed in the Strategy section.

This section aims to answer the following main questions		Sections questions will be addressed
1	What methodologies were previously used in PPM and framework construction literature?	2.1 Past methodological approaches
2	What is the nature of this study?	2.1 Past methodological approaches
3	What are the proposed steps taken by the chosen methodology?	2.2 Proposed process (Jabareen)
4	What are the steps that this study took to construct the framework?	2.3 Steps to a conceptual framework

2.1 PAST METHODOLOGICAL APPROACHES



The increasing interest in the field of project portfolio management has presented the body of knowledge with different topics and methodological approaches to understand the subject better. As noted in Chapter 2, studies on PPM have had a strong focus on the development of frameworks, tool, methods, and techniques of PPM (e.g. Cooper et al., 1999, 2001; Archer and Ghasemzadeh, 1999; Englund and Graham, 1999, etc.). To a large extent, the stream of studies was not supported by an empirical base (Cooper et al., 1999). Practitioners were seldom involved in testing or evaluating the developed tools or techniques, making the applicability among practitioners less likely (Dawidson, 2006).

Some authors have employed methodological approaches such as literature reviews and theoretical analysis (e.g. Ika, 2009; Archer and Ghasemzadeh, 1996; Meredith and Mantel, 1999, Martinsuo and Killen, 2014), multiple case studies (e.g. Fricke and1, 2000; Kaiser et al., 2015, Martinsuo et al., 2014), and single case studies that focus on a specific company or the application of a specific tool (e.g. Wynstra and Pietrick, 2000; Dyer, 1990, Stettina and Hörz, 2015). A common approach to the collection of data in this field of study was through surveys (e.g. Dietrich and Lehtonen, 2005; Killen et al., 2008; Müller et al., 2008; Shenhar et al., 2001; Teller and Kock, 2013) and interviews (e.g. Elonen and Artto, 2003; Kaiser et al., 2015, Blichfeldt and Eskerod, 2008). This study will also use surveys (web surveys) to gather information and make use of interviews to refine the results and draw the right conclusions.

Nature of the Study

Research approaches and standards are in transitions for PM and PPM since these disciplines are relatively new (Killen et al., 2012). As the disciplines of PM and PPM have increased in popularity, the methodological rigor has also increased. Some researchers use

conceptual models through statistical analysis and others use qualitative multi-case studies that involve analysis, observation, and in-depth interviewing (Turner, 2010). However, there are opportunities to further advance PM and PPM research by drawing upon established theories (Killen et al., 2012).

Due to the complexity of this study, qualitative and quantitative methods were used. Collis and Hussey (2003) classify types of research as: descriptive, analytical, predictive, and exploratory. Descriptive research use qualitative techniques that collect, analyse, and summarize data. Analytical research complements descriptive data by providing an in-depth understanding of the phenomena. Predictive research has a more speculative approach about the future, based on available evidence. Exploratory research is done when little or no research has been done on the identified phenomena. This study is descriptive and analytical by providing an in-depth understanding of PPM and the best practices. The study will be done through collecting, analysing, and summarizing relevant literature.

This thesis develops a framework for an empirical study that will explore the link between PPM implementation and achieving PPM success. To achieve this, a conceptual framework was developed by examining existing literature. A conceptual framework is a set of coherent concepts that assists with the understanding of how and why something took place (Moore et al., 2009). It is not to say that a conceptual framework is a tested theory, but it can contain a number of tested theories (Saunila, 2016). A conceptual framework links areas of knowledge and gives direction to the study of empirical problems (Moore et al., 2009).

This study follows a qualitative methodology similar to that proposed by Jabareen (2009) to develop a conceptual framework. The method proposed by Jabareen (2009) was deemed to be suitable as the main features of the conceptual framework are related to the main features in this study as seen in Table 6 below:

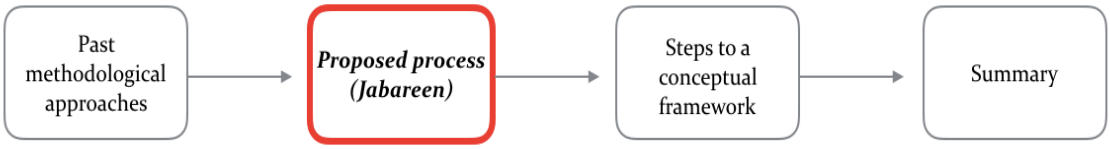
Table 6: Jabareen's main features compared with this study's desired features

	Main features of conceptual framework	Relation of main features to this study
1.	A conceptual framework is a construct where each concept plays an integrate role, rather than a construction of concepts	Factors that influence the portfolio success must be identified, analysed, and summarized in a framework
2.	It provides an interpretive approach to social reality	Many different studies have been done on PPM and the results need to be interpreted to construct the framework
3.	Conceptual frameworks provide understanding rather than a theoretical explanation	A clear understanding of PPM and the characteristics is needed for the framework and study to be effective
4.	Levering (2002) states that a conceptual framework provides 'soft interpretation of intention' rather than the hard facts.	PPM is used in different context and needs to be interpreted to apply to this particular study
5.	Conceptual frameworks do not enable the user to predict the outcomes	This study requires a framework that is not predictive, it is seeking to understand which factors influence success of PPM
6.	The conceptual framework can be constructed through a qualitative analysis process	The framework must be constructed through a thorough literature review
7.	The conceptual framework is built on sources of data that consist of many discipline-orientated theories	The framework must be constructed using various sources with different backgrounds and theories

Concepts that are interlinked as a network are defined as a conceptual framework; constructing frameworks based on grounded theory can be done through a conceptual framework analysis (CFA). The CFA can be modified to suit the user's study area; it is flexible, and emphasizes with the understanding of the study, instead of predicting it (Jabareen, 2009). This study will construct a conceptual framework with a focus on project portfolio management that is linked to different bodies of knowledge.

Grounded theory was first introduced by Glaser and Strauss (1967), but later specified by Strauss and Corbin (1990). Grounded theory is an interactive and comparative method (Smith, 2003), making it adequate for conceptual framework building. It consists of flexible, yet systematic guidelines for the collection and analysis of qualitative data to construct theories (Charmaz, 2014).

2.2 JABEREEN'S (2009) PROPOSED STEPS FOR DEVELOPING CONCEPTUAL FRAMEWORKS



Jabareen (2009) proposes 8 steps/phases for developing a conceptual model:

Phase 1: Mapping the selected data sources

This phase maps the spectrum of multidisciplinary literature related to the specific subject in question. Types of text and sources of data (such as empirical data) are identified in this phase. This phase starts with an extensive review of texts and it is also recommended to start initial interviews with specialists, practitioners, and scholars from various disciplines whose work focuses on the subject (Jabareen, 2009).

Phase 2: Extensive reading and categorizing of the selected data

This phase categorizes and selects the data by scale of importance, discipline, and representative power within each discipline. This process intends to maximize effectiveness, choosing the right data.

Phase 3: Identifying and naming concepts

The analyst is meant to discover concepts through reading and rereading the selected data (Strauss and Corbin, 1990). This method allows concepts to develop from literature, by finding, competing or contradicting concepts and by coding them (Jabareen, 2009).

Phase 4: Deconstructing and categorizing the concepts

Each concept is deconstructed to identify the main attributes, assumptions, characteristics, and role; this is done through organizing and categorizing the concepts according to their features and epistemological, ontological, and methodological role (Jabareen, 2009).

Phase 5: Integrating concepts

Concepts are grouped together and connected to new concepts through similarities. This phase conveniently reduces the number of concepts drastically into main characteristics (Jabareen, 2009).

Phase 6: Synthesis and resynthesizes

This phase is an iterative process that synthesizes and resynthesizes until a logical theoretical framework is recognized (Jabareen, 2009).

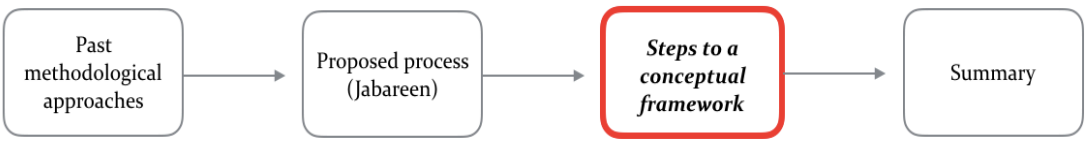
Phase 7: Validating the conceptual framework

The framework must make sense to the researcher, other scholars, and practitioner. This phase aims to validate the conceptual framework that can be done through the collection of feedback from external role players.

Phase 8: Rethinking the conceptual framework

With the necessary feedback from the validation phase, the theoretical framework is adjusted according to the new insights, comments, and literature.

2.3 STEPS TAKEN IN THIS STUDY



Towards developing a conceptual model, this study will follow an adapted version of Jabareen's process. This adapted process, with the steps followed during each of the phases, is described in the remainder of this section.

Phase 1: Mapping the selected data

Researchers of project portfolio management has used different methodological approaches during recent years. In accordance with CFA, a systematic literature review was done to identify and gather relevant information to contribute to the understanding

of PPM. The construction of the framework required an element of continuity intended to highlight the important aspects, by reviewing the inputs and by drawing conclusions.

The main objective of this thesis was to develop a conceptual framework that addresses the lack of empirical evidence on PPM employment and success. Literature was gathered through Stellenbosch Research Library database, Science Direct, Wiley Online Library, Project Management Journal, Emerald Insight, and Questia. The key words used to gather related literature were: project portfolio management; project links to strategy; project success; portfolio success; challenges in portfolio management; objectives of project portfolio management; assessing portfolios; and portfolio tools and frameworks. A list of 210 sources was included in this study, where 183 were used for the literature review. The reviewer used Atlas.ti to assist the process. Main aspects were coded to standardize the information and to identify the trends in literature.

Phase 2 and 3: Extensive reading and categorizing of selected data, identifying and naming concepts

Key coding words that were used and in Atlas.ti, were (in ranking order): PPM strategy; PPM decision making; single-project-level characteristics and activities; strategy link to projects; multi-project level characteristics and activities; availability and quality of project information; business strategy; portfolio success; PPM definitions. The most frequently coded constructs were PPM strategy and PPM decision-making. This could indicate that literature has dedicated many studies to the understanding of PPM strategy and what tools to use for the decision-making process. However only quotes relevant to this study were coded and this did not indicate whether the decision-making practices of PPM were actually implemented.

Phase 4: Deconstructing and categorizing the concepts

Phase 1, 2, and 3 were carried out to construct Phase 4. Phase 4 aimed to deconstruct and categorize concepts by identifying concept attributes, assumptions, characteristics, and their role (Jabareen, 2009). From this process of deconstruction and categorization, three important themes were identified: the objectives of PPM; the challenges often faced in executing PPM; and the approaches to assessing PPM (tools, and frameworks). Jabareen

(2009) identified whether concepts are ontological (philosophical study of reality) or epistemological (how things work in reality), but that is not suited for this particular study.

Phase 5: Integrating concepts

Once the objectives, PPM challenges, tools, and frameworks for PPM were established, it was possible to identify the possible success factors and criteria. Phase 5 conveniently reduces the number of concepts drastically into main characteristics (Jabareen, 2009). This phase has two aims of grouping: categories of success factors and success criteria. One of the few empirical studies done on successful management of strategic intention through multiple projects, was by Dietrich and Lehtonen (2005), who identified four category factors that this study adopts. The category factors were frequently coded through the PPM literature found in previous phases. Therefore, it is decided to use the same four categories for the development of the conceptual framework. The four category factors are the following: (1) single-project-level characteristics and activities; (2) multi-project level characteristics and activities; (3) links between projects and strategy process; (4) availability and quality of project information.

Success factors and success criteria go hand in hand; the influence of the factors on the portfolio must be measured. Success is defined differently across industries; the context of projects varies and therefore the definition of success varies as well (Shenhar et al., 2001). The four success criteria identified were: (1) Linking the portfolio to the organization's strategy; (2) Balancing the projects within the portfolio; (3) The average single-project success of the portfolio; and (4) Use of synergies.

Phase 6: Synthesis and resynthesis

This phase aimed to create a conceptual framework from the foundation of solid research done in the previous phases, which identified factors related to managing strategic intention through a portfolio. The links between different concepts that are related to the four success factor categories from Phase 5, were identified. By identifying the links and different concepts that are related to the four category factors, a logical framework was constructed. Each category factor had relevant subfactors; the subfactors were identified

in other similar studies and presented frequently in PPM literature. The objective of this study is to create a conceptual framework that identifies factors related to managing strategic intention through a portfolio. The subfactors are constructed from of the extensive research of potential success factors that can be tested empirically.

Phase 7: Validating the conceptual framework

The next step to be taken is validating and rethinking the conceptual framework as seen in Figure 4. This phase was completed when the literature study and framework article was: (1) published in the South African Journal for Industrial Engineers (SAJIE), and (2) presented at the South African Institute for Industrial Engineering (SAIIE) conference.

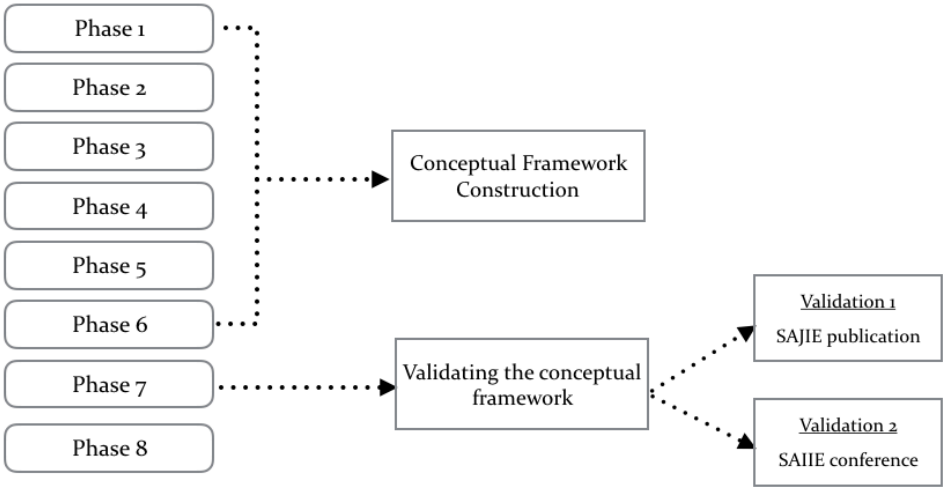
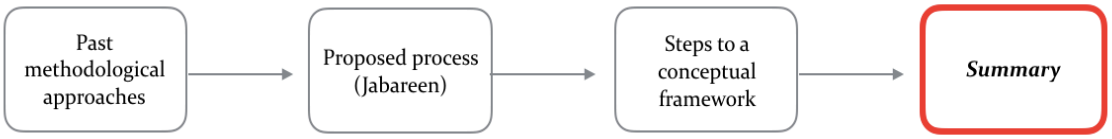


Figure 4: shows how Phase 7 was divided into two stages

Phase 8: Rethinking the conceptual framework

Three reviewers examined the article, although there were some spelling errors, no major changes to the framework were necessary. After the feedback from the SAJIE about the recommended changes to the article, the framework was finalized.

2.4 SUMMARY



Researchers of project portfolio management have used different methodological approaches during recent years. In accordance with CFA, a systematic literature review was done to identify and gather relevant information to contribute to the understanding of PPM. The construction of the framework required an element of continuity that intended to highlight the important aspects by reviewing the inputs and drawing conclusions. The following Table 7 is a short summary of each phase:

Table 7: The process followed to construct and validate the conceptual framework

Phase	Objective of phase	What was done	Where presented in this thesis
Phase 1: Mapping the selected data sources	Identify PPM literature	A list of 210 sources were used for a systematic review	Foundation for Chapter 2
Phase 2: Extensive reading and categorizing of the selected data	Identify data categories	Studies were coded by identifying key words and by using Atlas.ti	
Phase 3: Identifying and naming concepts	Develop concepts from extensive reading of literature		
Phase 4: Deconstructing and categorizing the concepts	Identify main attributes, characteristics, assumptions and roles of each concept	Objectives, PPM challenges, and assessment tools for PPM were identified	Chapter 2 - Project Portfolio Management Practices - Objectives - Challenges - Tools and Frameworks
Phase 5: Integrating concepts	Group similar concepts	Success factors and success criteria were defined	Chapter 2 - Success Factors - Success Criteria
Phase 6: Synthesis and resynthesis	Develop a conceptual framework	Concepts were divided into the four factor categories to create the conceptual framework	Chapter 2 & 3 - Success Factors - Steps explained for conceptual framework development
Phase 7: Validating the conceptual framework	Validate the conceptual framework through feedback	The framework was presented in an article and sent to the SAJIE; this was	Chapter 4 - Summary of authors, - Framework validation

		accepted for publication	
Phase 8: Rethinking the conceptual framework	Identify lessons learnt from conceptual framework	The feedback from the reviewers were taken and adjusted accordingly	Chapter 4 - Framework validation

The Figure 5 below is a visual representation of the steps that were taken in each phase, of Jabareen's (2009) proposed process, and to show how the final framework was achieved.

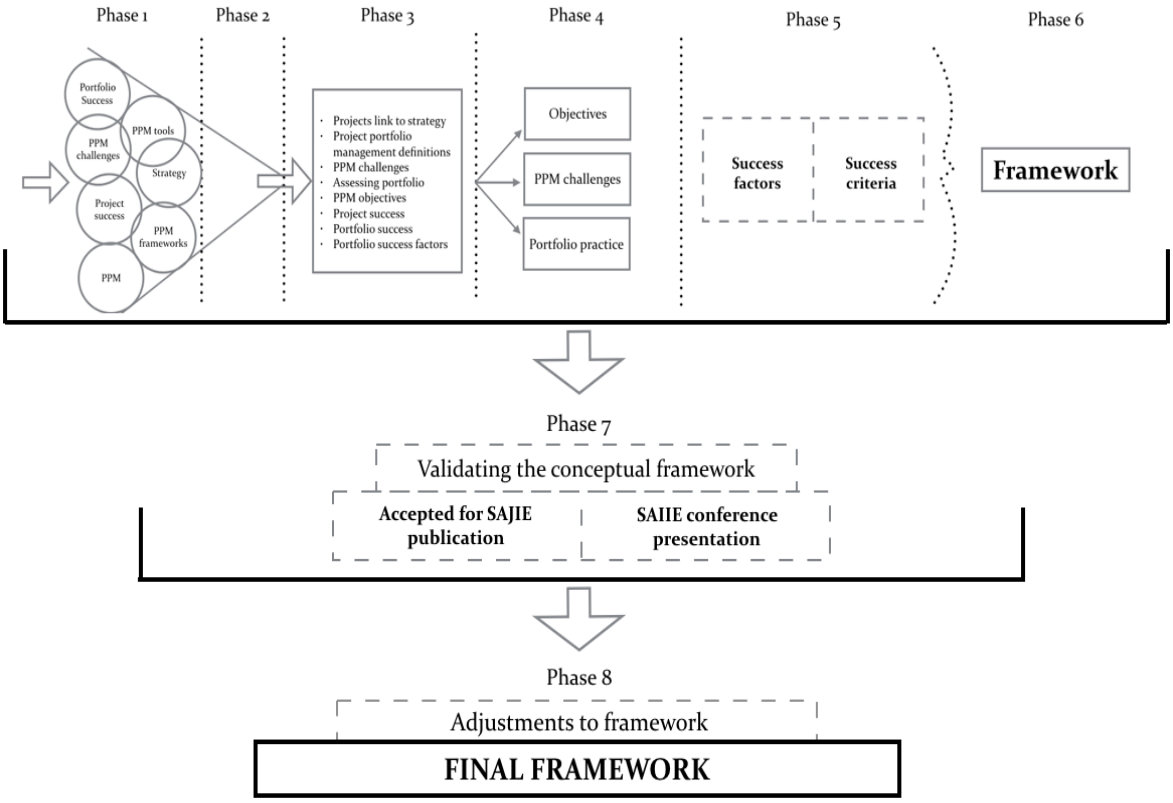


Figure 5: Steps followed to conduct and validate the conceptual framework

CHAPTER 3 - LITERATURE REVIEW

This chapter is divided into three major sections: strategy, project portfolio management, and success. Figure 6 below shows what will be discussed in each section:

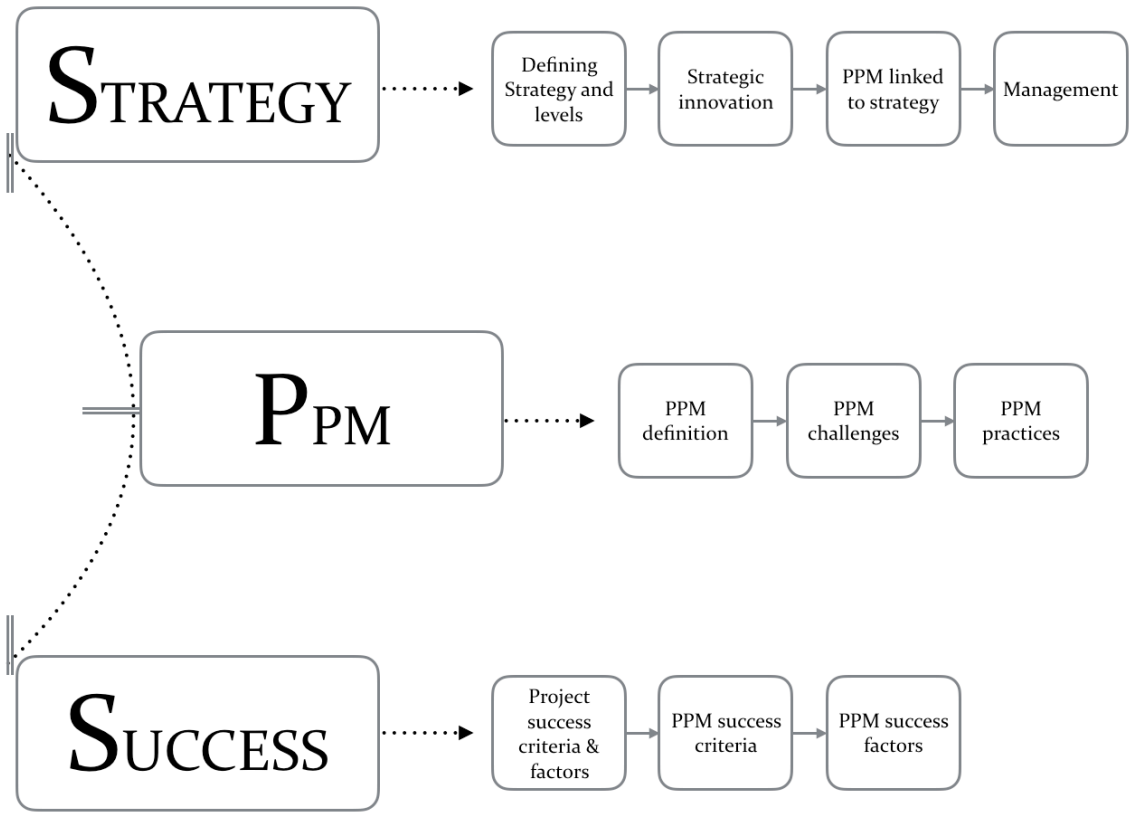


Figure 6: Literature study's main sections

STRATEGY

Organizations need efficient strategy processes to address the challenges in their changing environment. Strategy implementation is a part of this strategy process and as a result, interest in project portfolio management has increased. A strategy is formulated by developing a broad formula that states the goals (mission/objectives) and the policies needed (Porter, 1980). Project portfolio management is the coordination of one or more portfolios to achieve the organization's strategic objectives. Strategic transformation cannot be accomplished without senior management getting deeply involved in project management (Hyväri, 2014); projects too have a relationship with its portfolio (Project Management Institute, 2013). Figure 7 is the process that was followed to answer the questions in Table 8 that are addressed in this chapter.

Figure 7: Steps followed to answer questions about strategy

Table 8: the main questions and where it is addressed in the section of Strategy

This section aims to answer the following main questions		Sections questions will be addressed
1	What is strategy and why is it important to the organization?	3.1 Defining strategy and the levels
2	What are the different levels of strategy?	3.2 Strategy levels
3	What is strategic innovation?	3.3 Strategic innovation
4	How is PPM linked to the questions above?	3.4 PPM linked to strategy
5	What are the different management types and how do they fit into the levels of strategy?	3.5 Management

3.1 DEFINING STRATEGY

A plan of action that is designed to achieve a particular goal is often defined as a strategy. Strategy as a field, has evolved; firms have learned to define their position in the market, analyse their competitive environments, acquire competitive and corporate advantage, and understand the threats to sustaining that advantage (Casadesus-Masanell and Ricart, 2010).

Before PPM is discussed, an overview of strategy will be explored. Morris and Jamieson (2005) argue that a hierarchy is usually important in any strategic implementation discussions (see levels of strategy in Figure 8). The business can become complex, but by understanding the order of strategies and problems, solutions can more likely be identified.

Defining strategy

Competitive strategy with its core disciplines of competitor analysis, strategic positioning, and industry analysis, are now an accepted part of common management practices. Connecting a company to its environment, is the essence of formulating a competitive strategy (Porter, 1998). The environment refers to the industry or industries in which the company competes, including the economic and social forces. An organization's competitive strategy also specifies the potential markets, objectives, products, and policies (for achieving the objectives) (Singh et al., 2008).

Drivers such as globalization, technological change, or deregulation – to mention a few – are constantly changing the rules of the competitive game. Practitioners and scholars agree that the leading firms are those who have taken advantage of this changing environment by competing 'differently' and being innovative in their business model (Casadesus-Masanell and Ricart, 2010).

3.2 STRATEGY LEVELS

The three levels of strategy are explained in the figure below:

Figure 8: Levels of strategy (corporate-, business-, and functional level strategy)

Corporate Level Strategy

Corporate strategy is the direction an organization would like to pursue with the objective to achieve long-term business success. The process to develop a corporate strategy, involves establishing the nature of the business, the scope, and the purpose of the organization's activities (Wheelwright, 1984; Singh et al., 2008). Corporate strategies have a broad view of plans for the whole organization and changes as the market or industry conditions change. This oversight of the entire business scope and operations is advantageous when assessing the organization's competitive strengths and weaknesses.

The grand strategies can be defined as comprehensive plans that the organization should use to achieve long-term objectives (Pearce et al., 1987). Grand strategies involve efforts to decrease the scope of the business operations (retrenchment strategies), to expand the business operations (growth strategies), or maintain status quo (stability strategies).

The three grand strategies are:

(1) **Growth strategies (internal and external)** expand the organization's performance, which is usually measured by product mix, profits, sales, market

share, market coverage, or other market-based and accounting variables. Growth strategies could typically include the following: concentration strategy, vertical integration strategy, or diversification strategy.

(2) **Stability strategy** is essentially the continuation of the existing strategy (Pearce et al., 1987). This strategy is used in environments that are more stable. The firm may decide that the current rate of growth and profits satisfy their needs and they see no need to expand further.

(3) **Retrenchment strategy** is the reduction in the scope of the organization's activities. The organization tries to improve its performance by scaling down in the level and/or scope of market/product objectives (Pearce et al., 1987). The reduction can be done by selling assets related with the discontinued products or service line, reducing the number of employees, restructuring debt through bankruptcy actions, or in some severe cases liquidating the firm. The firm might consider to use: turnaround strategy, divestment, bankruptcy, or liquidation.

Business-Level Strategy

Business level strategy is concerned with succeeding in the chosen markets. Business units represent individual entities, which are orientated towards a particular product, industry, or market. Every strategic business unit will more likely have its own product, industry and competitors, forming its own distinctive strategy. Decisions regarding the products and sometimes using strategies relating to corporate-level, are commonly found under business-level strategy. Corporate level strategy is supported through business level strategy by being concerned with matching activities to the objectives of the corporate level strategy, while simultaneously piloting the markets in which they compete to have a competitive edge (Thomas, nd).

De Wit and Meyer (2004) state that organizations have to integrate the functional level strategies to be effective at this level. Michael Porter (1985) developed a framework that is still referred to in literature today as general strategies that can be applied to in various services and products, or to the individual business level strategies that are within a corporate's portfolio.

(1) Cost leadership

(2) Differentiation

(3) Focus

Similar to Porter's framework, Katz et al. (2011) identified four generic classifications under the grand strategies explained in section 2.2.1. The key strategic perspectives are as follows:

- **First to market strategic perspective** –the early mover, aggressive and offensive, proactive, and leadership orientation. An empirical study (of 182 surveys) done by Dyer et al. (1999) indicated that first-to-market firms did better overall in dimensions of new product performance.
- **Reactive Strategic Perspective** – is described in a number of ways such as imitative, defensive, second but better, fast follower (Akman and Yilmaz, 2008; Dyer et al., 1999). It improves on another firm's innovation in order to compete, e.g. with high volumes as low cost.
- **Niche Player strategic perspective** – the specialists who focus on one area intensely and they exploit this area. Niche players can also be defined as defenders of market share in the specific field.
- **Cost reducer strategic perspective** – offering low price products or services to gain a competitive advantage. A great deal of managerial attention is required to achieve the low-cost objectives (Porter, 1998).

Functional Level Strategy

Functional level strategies are mostly concerned with coordinating the functional parts of the organization to meet the goals or the business level strategies and ultimately the corporate level strategies. To be internally consistent is having an overarching functional strategy that incorporates several functional subcategories. If the strategy is aligned with the demands in the significant external arena, then the external consonance is fulfilled (de Wit and Meyer, 2004).

3.3 STRATEGIC INNOVATION

Strategic management assists process and product innovation to become successful. Strategy determines the configuration of systems, processes, products, and resources allowing the organization to adapt to its environment. Strategy requires the knowledge of which work and functions should be made in which market, in other words a successful innovation plan needs to determine the strategic orientation (Akman and Yilmaz. 2008). Tidd and Bessant (2013) propose three key steps in putting an innovation strategy together and in determining the strategic orientation:

- Strategic analysis: what could the organization do?
- Strategic selection: what is the organization planning to do, and why?
- Strategic implementation: how is the organization going to end up making it happen?

Strategic analysis

This begins with exploring the innovation space by identifying where innovation can take place and if it is worth doing so. Typical questions can relate to markets, technologies, emerging customer needs, underlying political trends, competitors (number and type), and social and economic forces. It is also important to reflect on the resources the organization can apply and their relative strength and weaknesses. Bessant and Francis (2005) describe four dimensions of innovation and the relevant types of changes in Table 9 below.

Table 9: Dimensions of innovation (Bessant and Francis, 2006)

Dimension	Types of change
Product	The products or services the organization offers
Process	The ways in which these offerings are delivered and/or created
Position	The context into which the products or services are introduced
Paradigm	The underlying mental models, which frame what the organization does

Strategic Selection

All the things that could be done must be identified and the appropriated ones must be completed. Strategic competencies and capabilities must be recognized through accumulated knowledge and other resources. There are different approaches to project selection, all with their own advantages and disadvantage (Tidd and Bessant, 2013):

- **'Gut feel' intuition** – fast but lacks evidence
- **Financial measures** - fast and simple, but they do not consider other benefits in the form of innovation
- **Multidimensional measures** – compares several measures, but level of analysis may be limited
- **Portfolio methods and business cases** – detailed evidence, but takes a long time

Strategic position of the organization or business unit must be captured to understand the wider system and where competitive advantage can be created through innovation. Selecting innovation projects requires much consideration to be taken on the internal and external factors (Akman and Yilmaz, 2008). Michael Porter's (1989) framework is useful to look at regarding innovation and gaining a competitive advantage amongst a network of other organizations; strategic posture of how the business unit or organization is planning to execute their plan; is the organization for example first movers in the market or are they fast followers (as explained under Business-Level Strategies).

Strategic Implementation

Having decided on what the organization could do and what will be done, allows for the third stage to be developed and implemented. This stage will need to look at the source of the resources, like roadblocks, partnerships and the steps to implementation (Tidd and Bessant, 2013).

It is in the best interest of the organization and management to be aware of the potential factors that oppose strategy implementation. Beer and Eisenstat (2000) identified six major 'killers' for strategy implementation:

(1) Top-down or laissez-faire senior management style
(2) Unclear strategy, as well as conflicting priorities

(3) Ineffective senior management team

(4) Poor vertical communication

(5) Poor coordination across functions, businesses or borders

(6) Inadequate down-the-line leadership skills and development

3.4 PPM LINKED TO STRATEGY

Patanakul's (2015) study suggests that strategy researchers agree that strategic fit is static in nature and probably on its own it is inadequate to address the unpredictable, dynamic, and competitive environment the business is possibly in. Strategic flexibility is a solution suggested by researchers to overcome these challenges (Nadkarni and Narayanan, 2007; Hitt et al., 1998), however, Patanakul's (2015) study states that PPM keeps the employees up to date with the uncertainties of their business environment and ensures that the portfolio is adaptable to those challenges. In PPM literature, evaluating, prioritizing, and selecting projects based on strategy is encouraged (Englund and Graham, 1999; Spradlin and Kuoloski, 1999).

Müller et al. (2008) showed that portfolio management performance could be positively influenced by strategic portfolio selection. They also concluded from their literature study that the portfolio selection approach must be fitted to the organization's characteristics. Shenhar et al. (2001) stated that project portfolio planning must be an integral part of an organization's thinking and strategic planning. Projects can be used as a powerful strategic weapon to create a competitive advantage and economic value; projects will become the factors that drive strategy into new directions and they will no longer be operational tools (Shenhar et al., 2001).

Although this study does not intend to provide a complete review of literature that links PPM practices to strategy, the following table does offer some themes to illustrate the

concept. Table 10 serves to link the focus of this section (strategy) to that of the next section (PPM). Table 10 shows an overview of the similarities between PPM and strategy with possible tools and frameworks that could be useful in planning the strategy. The tools and frameworks are case specific, but the table does suggest which tools may be helpful to each strategy type.

Table 10: Similarities between PPM and strategy

Strategy type discussed	Overviewed link to PPM	Possible useful tools and frameworks
Corporate level strategy • Growth • Stability • Retrenchment	By splitting general strategies into functional strategies or business unit strategies, firms have traditionally implemented their corporate strategy. Another complementary way to translate corporate strategy into a portfolio of projects, is through PPM. PPM allows managers to link strategy with a closer final picture of the desired results. Although PPM is an ever-changing and continuous process, the design starts with the corporate strategy definition (Pajares and Lopez, 2014). PPM has to plan for the future of the organization: short-term and long-term. The vision and mission of the organization must, at all times, be kept in mind when making decisions on where the company aims to grow, to stay stable, and/or to retrench. It must be clear which projects are going to be cut from the portfolio, which are going to be a priority and which are still being researched (Reyck et al., 2005; Benaija and Kjiri, 2015; Archer and Ghasemzadeh, 2004).	• Scoring models • Road mapping • Comparative approaches • Stage-gate framework • Framework by Patterson
Business level strategy • Cost • Differentiation • Focus	PPM practices make it easier for the organization to achieve a competitive advantage, by using the right portfolio analysing tools and frameworks. Cost can be managed and compared through financial methods; the potential projects can be measured and effectively analysed for portfolio differentiation; the organization could focus on a specific area by making use of market analysis tools and then optimize operations by making use of synergy and resource distribution tools. Pinto (2007) summarized the link between project management, PPM, and strategy: 'One of the most effective methods for aligning the profit objectives and strategic plans is the development of a proactive project portfolio.'	• Expected Commercial value • Productivity Index • Bubble diagrams • Framework by Archer and Ghasemzadeh (1999) • Framework by Patterson
Functional-level strategy • Finances • Human resources • Information systems • Marketing • Production/ Operations • R&D	PPM practices focus on what must happen to have the best outcome for the organization. The main objectives stated by Cooper et al. (2002) of PPM are to: (1) maximize value, (2) balance the portfolio, (3) align the projects strategically, and (4) have the right number of projects. These objectives must take the functional level strategy and plan how the flow of projects will occur and which projects best fit with the rest of the portfolio by making use of their synergies. PPM is a set of practices that integrates projects with other business operations (Levine, 2005). Literature proposes that PPM	• Optimization models • Dynamic ordered ranking lists • Resource demand models • Framework by Englund and Graham (1999)

	is the performing of strategy through projects as well as the ability of projects and portfolio activities to inform and guide the strategic development (Killen et al., 2012).	
Strategic perspective • First-to-market • Reactive • Niche player • Cost reducer	Whatever the perspective of the organization, PPM can be used to execute the intention of the strategy. First-to-market perspectives would use PPM as a means of analysing the market and determining if the risk is worth the potential reward. Reactive perspectives must be acted upon quickly and one also needs to analyse the market for the potential gaps that first-to-market perspectives might not have identified. Reactive, niche players, and cost reducers especially, could all focus on means to reduce cost by making use of synergies among projects.	• Variety of tools, very dependent • Framework by Patterson • Market analysis
Strategic innovation • Strategic analysis • Strategic selection • Strategic implementation	As stated in section 3.8, portfolio methods are one of the approaches to project selection. As with PPM, there are key things to format strategic innovation; the process is closely linked to the PPM practices. Frameworks such as the stage-gate can assess potential projects where projects have to be analysed, selected, and then implemented. All the projects must be compared with different measures to ensure that the best-fit portfolio is decided upon for the organization. Many PPM frameworks have been developed (e.g. Englund and Graham, 1999; Archer and Grasemzadeh, 1999; Patterson, 2005; Cooper et al., 2009; Koen, 2005) and indicate that PPM could be regarded as a system for managing product development (Martinsuo, 2013).	• Most of the tools and frameworks for PPM • Stage-gate framework • Framework by Archer and Ghasemzadeh (1999)

As illustrated in Table 10, portfolio management aims to contribute towards achieving the organizational strategies and objectives of an organization. PPM supports the development of the strategies by providing valuable information. Hyväri (2014) mentions that although practices such as project management are useful, unfortunately most executive strategic thinkers have not yet learnt the language of it. However, the trend of interest and research done in the field of PPM and strategy topics, has increased steadily for the last 50 years and is expected to continue to increase (Kwak and Anbari, 2009).

As suggested by conceptual research, business strategy has a connection to PPM and its success (Archer and Ghasemzadeh, 1999; Meskendahl, 2010; Martinsuo, 2013). The portfolio plan influences the strategy in mainly five areas: measuring portfolio component performance and risk management, allocating financial resources, allocating human resources, allocating material or equipment resources, and maintaining alignment to the strategic objectives (PMI, 2013).

The alignment of the portfolio with the organization's strategic direction is directly correlated to the effectiveness in managing the project portfolio (Patanakul, 2015). It is not just the organization's strategy that relies on PPM practice, but it is also the PPM practices that rely on the organizational strategy.

Clearly PPM is closely related to the organization's strategy. Further on in the study this point will be restated by considering what literature proposes the success criteria of PPM must be; the most frequent success criteria are the alignment of the projects with the organization's strategy (see Section 3.10.1).

3.5 MANAGEMENT

To be successful in strategy implementation, there is a need for senior management to be involved in project management (McElroy, 1996). As mentioned by Morris and Jamieson (2005), good governance requires several things such as the formal alignment between project plans, programs, portfolios, the business, and transparent reporting of risk and status to the board. Operational issues may also require senior management involvement. There is also upward flows of information, e.g. from the business units to the corporate level. A fundamental responsibility of project and/or program management is to manage resources; this is a critical factor when implementing corporate strategy into projects (Morris and Jamieson, 2005). A portfolio has relationships with its components and projects (PPM, 2013). Morgan et al. (2007) state that strategic transformation can only be accomplished when senior management can engage deeply in project management, but unfortunately strategic thinkers and executives have yet to learn the language of project management.

This study will use Yuming et al.'s (2007) framework of application of project portfolio, program, and project management in Enterprise Strategic Management (ESM). The adjusted figure below is adapted from Yuming et al. (2007), which illustrates the different

management types linked to the levels of strategy. Figure 9 below is in close relation to Figure 8 in Section 3.2.

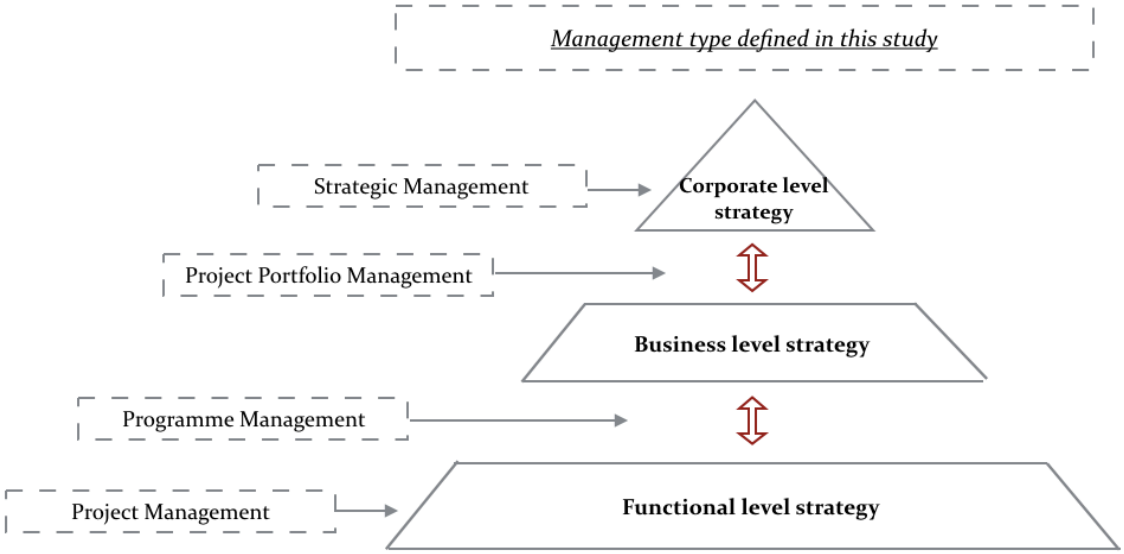


Figure 9: The levels of management defined in this study, adapted from Yuming et al. (2007)

The responsibilities that Yuming et al. (2007) dedicate to each management role are the following:

Strategic Management - vision mission, objectives, and goals

Project Portfolio Management - proposals, prioritization, and selection

Program Management - building competitive advantage, response to changing conditions, and collaboration

Program Management - proposed initiatives, cost benefit analysis, sponsorship approval, project prioritization, and measure results

Project Management- initiate, build, analyse, validate, design, and implement

Small businesses do not necessarily have official project portfolio managers, but they rather have the responsibilities of a project portfolio manager spread out across different management levels. Project portfolio management is tightly aligned to strategic business objectives (Yuming et al., 2007). The roles and responsibilities of management type may differ from organization to organization. According to Elonen and Artto (2003), a major problem in managing a multi-project environment is the unclear roles and responsibilities between the decision makers (of the portfolio) and other parts of the organizations. Unger

et al. (2012) proved in their study that having a Project Portfolio Management Office (PPMO) that coordinates and controls projects, does have an impact on the PPM quality, which predicts PPM success.

Morris and Jamieson (2005) state that elements of strategy management are covered in both business and corporate as well as management roles. Project portfolio management is applying skills, techniques, and tools to a collection of programs or projects. This will be discussed later in section 3.8. Program management is a way of coordinating projects that have a shared business aim. The difference between program management and portfolio management, is that portfolio management is more periodic and program management is more involved in every day implementation management (Morris and Jamieson, 2005). Project management has a single development life cycle; this will elaborated upon in section 3.9.2. The Project Management Body of Knowledge (PMBOK) (PMI, 2008) has summarized comparisons between projects, programmes, and portfolios in Table 11 as follows:

Table 11: Comparative Overview of Projects, Programmes, and Portfolios adapted from PMBOK 4th edition

	Projects	Programs	Portfolios
Scope	Projects have defined objectives. Scope is progressively elaborated throughout the project life cycle.	Programs have a larger scope and provide more significant benefits.	Portfolios have a business scope that changes with the strategic goals of the organization.
Change	Project management expects change and implement processes to keep change managed and controlled.	The program manager must expect change from both inside and outside the program and be prepared to manage it.	Portfolio managers continually monitor changes in the broad environment.
Planning	Project managers progressively elaborate high-level information into detailed plans throughout the project life cycle.	Program managers develop the overall program plan and create high-level plans to guide detailed planning at the component level.	Portfolio managers create and maintain necessary processes and communication relative to the aggregate portfolio.
Management	Project managers manage the project team to meet the project objectives.	Program managers manager the program staff and the project managers; they provide vision and overall leadership.	Portfolio managers may manage or coordinate portfolio management staff.
Success	Success is measured by product and project quality, timeliness, budget compliance, and degree of customer satisfaction.	Success is measured by the degree to which the program satisfies the needs and benefits for which it was undertaken.	Success is measured in terms of aggregate performance of portfolio components.
Monitoring	Project managers monitor and control the work of producing the products,	Program managers monitor the progress of program components to ensure the	Portfolio managers monitor aggregate performance and value indicators.

	services or results that the projects was undertaken to produce.	overall goals, schedules, budget, and benefits of the program will be met.	

For this study, all the different types of management mentioned, are going to be included since project portfolio management can be used on all levels and need information from different management types to make effective decisions. Table 7 above explained how PPM could be linked to each level (corporate, business, and function) of strategy. The purpose of this study is to determine the best project portfolio management practices and to ensure there are no practices overlooked, due to organizations having different roles and responsibilities under different titles of management.

PROJECT PORTFOLIO MANAGEMENT

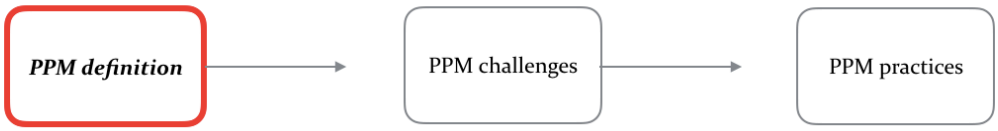
The PPM literature has changed over the years; Dawidson (2006) is stating that the portfolio management extends beyond the evaluation techniques, towards a more complete managerial approach on how PPM is practiced. Coordinated PPM represents the organization's investment strategies (Dye and Pennypacker, 1999) and it uses synergies to deliver larger benefits to the organization than independently managed projects (Platje et al., 1994; Loch and Kavadias, 2002). Consequently, the multifaceted goals and benefits of a portfolio must be established before the selection of projects can take place to meet the organization's overall objectives (Meshendahl, 2010). As explained in the previous section on strategy, corporate strategy is generally operationalized on a business level, it is filtered to the portfolio level, and eventually to the project level (Archer and Ghasemzadeh, 1999), making it necessary to strengthen the links between levels for effective and efficient work to be done. This section aims to give a general understanding about the practices of PPM. Figure 10 is the process that was followed to answer the questions in Table 12 that are addressed in this chapter.

Figure 10: Steps followed to answer the questions about PPM

Table 12: The main questions and where it is addressed in the section of PPM

This section aims to answer the following main questions		Sections questions will be addressed
1	What is the definition of PPM?	3.6 PPM definition
2	What benefits can be expected when incorporating PPM practices?	3.6 PPM definition
3	What are the complexities and assumptions that are made with PPM?	3.6 PPM definition
4	According to literature, what are the challenges faced by portfolio managers?	3.7 PPM challenges
5	Which tools are used for PPM?	3.8 PPM practices - tools
6	What are the different types of frameworks used for PPM?	3.8 PPM practices - frameworks

3.6 DEFINE PROJECT PORTFOLIO MANAGEMENT



According to Platje et al. (1994), a portfolio's definition is similar to that of a 'programme'; it is a set of projects that are coordinated and managed in a certain way to bring benefits to the company, which would not have been possible if the projects were managed individually. Archer and Ghasemzadeh (1999), define a project portfolio as a group of projects, conducted under the management and/or sponsorship of an organization, that share and compete for scarce resources.

Project portfolio management (PPM), although widely researched, has evolved as this discipline has become more established. Artto and Dietrich (2004), Patanakul and Milosevic (2009), and Dietrich and Lehtonen (2005), define PPM as the simultaneous management of a whole collection of projects as one big entity. Cooper, Edgett and Kleinschmidt (1997) define PPM as a decision process, of the business's new, active, and R&D projects, which needs to be updated and revised constantly. Similar to Cooper et al.'s definition, Blichfeldt and Eskerod (2007) define PPM as the managerial practices that relate to: (1) screening, selecting, and prioritizing project proposals, (2) projects in a portfolio being constantly reprioritized, (3) ranking projects according to priority, and then (4) allocating and reallocating resources to the best suited projects. Dye and Pennypacker (1999, 2002) refer to PPM as the application of a set of tools, techniques, knowledge, and skills to a collection of projects that aim to achieve the organization's strategy.

3.6.1 BENEFITS OF PPM

Organizations face four general problems when there is a lack of PPM practices: (1) unbalanced portfolio (2) projects are not linked to the strategic goals (3) project that do not add value are in the portfolio (4) too many active projects in the portfolio (Kendall and Rollins, 2003). Other problems identified by Payne (1995) are the lack of coordination

between projects, late delivery on projects, unexpected resource bottlenecks, conflicting project objectives, disappointment with final project benefits, cross-functional working, and resistance to organizational changes.

Successful PPM could deliver additional benefits to an organization beyond that of time, quality, and budget (iron triangle) (Meshendahl, 2010). Bhaskar (2016) did a structured survey to explore the benefits of PPM technique in the manufacturing industry. The study found the following benefits of PPM:

(1) Zeroing in on the right product/project
(2) Investment of funds in appropriate business areas
(3) Elimination of efforts on product/project redundancies
(4) Elimination plans of unyielding projects
(5) Optimal allocation of resources
(6) Role of PPM on increased cost savings
(7) Alignment levels of products/projects with business strategy
(8) Impact of profits
(9) Identifying and managing gaps in the product portfolio
(10) Contribution to reduce time to market
(11) Identifying appropriate technology to align with market dynamics

The value-enhancing analysing actions that are taken with PPM are valuable to the organization (Spradlin and Kutoloski, 1999). Blomquist and Müller's (2006) study indicated that portfolio management improved the firm's market position substantially relative to their competitors. They state that poor financial performance and perception generally triggered the use of PPM.

Some of the following benefits could be expected when adopting PPM approaches: (1) maximizing value of investments while minimizing the risks; (2) improving communications and business leaders alignment; (3) improving resource distribution and terminating some projects (Reyck et al., 2005). This supports the literature that suggests that PPM is a practice that combines organizational focus by selecting the projects aligned

with the strategy, with the PM focus of delivering projects effectively and according to plan (PMI, 2006).

3.6.2 PORTFOLIO COMPLEXITY

As the projects increase in number and size, the complexities and management challenges increase (Teller et al., 2012). Project portfolio practices are dynamic and not a static process; new projects continuously claim to be included in the portfolio, as strategic, new market, or technical opportunities emerge. Research often refers to complexity as a main contingency in PPM (Voss and Kock, 2013; Teller et al., 2012; Heising, 2012). Complexity has numerous interpretations.

The size of the organization and portfolio, influences the formalization of the portfolio process (Martinsuo and Lehtonen, 2007; Teller et al., 2012). The larger the portfolio, the more difficult it becomes to sustain transparency. Kopmann et al., (2014) argues that the contribution of business case control to portfolio success, increases with the number of projects in the portfolio.

Practice and theory differ when it comes to the complexities and management of multi-projects. An example of this is the allocation of resources. In theory, resources could be shifted from one project to another to optimize the portfolio's performance. However, in practice human resources cannot be moved without reducing productivity (Pajares and López, 2014). Some projects might need specific resources assigned to them, while others might be easier to complete. Multitasking increases the likelihood of making mistakes and delaying the project. To face this challenge, Kruger and Scholl (2009) proposed to include resource-dependent transfer times that take into account setup activities performed when resources are moved from one project to another.

Industry Classification

Complexity is also affected by the industry which the project or portfolio needs to act in. The National Small Business Amendment Act (The National Small Business Amendment Act, 2003) aims to further define the National Small Business Act (National Small Business Act, 1996) according to the five categories established by the original act: sector or

subsector in accordance with the Standard Industrial Classification, size of class, total fulltime equivalent of paid employees, total turnover, total gross asset value (fixed property excluded). Table 13 shows the classification of the following: very small, small, and medium businesses.

Table 13: SME size class breakdown according to the National Small Business Act (Act No. 102, 1996)

Sector or subsectors in accordance with the Standard Industrial Classification	Size or class	Total full-time equivalent of paid employees	Total annual turnover in Rands	Total gross asset value in Rands (fixed property excluded)
		Less than:	Less than:	Less than:
Agriculture	Medium	100	4,000,000	4,000,000
	Small	50	2,000,000	2,000,000
	Very small	10	400,000	400,000
Mining and Quarrying	Medium	200	30,000,000	18,000,000
	Small	50	7,500,000	4,500,000
	Very small	20	3,000,000	1,800,000
Manufacturing	Medium	200	40,000,000	15,000,000
	Small	50	10,000,000	3,750,000
	Very small	20	4,000,000	1,500,000
Electricity, Gas and Water	Medium	200	40,000,000	15,000,000
	Small	50	10,000,000	3,750,000
	Very small	20	4,000,000	1,500,000
Construction	Medium	200	20,000,000	4,000,000
	Small	50	5,000,000	1,000,000
	Very small	20	2,000,000	400,000
Retail and Motor Trade and Repair Services	Medium	100	30,000,000	5,000,000
	Small	50	15,000,000	2,500,000
	Very small	10	3,000,000	500,000
Wholesale Trade, Commercial Agents and Allied Services	Medium	100	50,000,000	8,000,000
	Small	50	25,000,000	4,000,000
	Very small	10	5,000,000	500,000
Catering, Accommodation and other Trade	Medium	100	10,000,000	2,000,000
	Small	50	5,000,000	1,000,000
	Very small	10	1,000,000	200,000
Transport, Storage and Communications	Medium	100	20,000,000	5,000,000
	Small	50	10,000,000	2,500,000
	Very small	10	2,000,000	500,000
Finance and Business Services	Medium	100	20,000,000	4,000,000
	Small	50	10,000,000	2,000,000
	Very small	10	2,000,000	400,000
Community, Social and Personal Services	Medium	100	10,000,000	5,000,000
	Small	50	5,000,000	2,500,000
	Very small	10	1,000,000	500,000

This study will classify the size of the businesses with the assistance of classifications used in the National Small Business Amendment Act (Act No. 26, 2003), with particular focus on the number of employees. The Education industry was added to the list used in this

study to gain insight from researchers in the field, as recommended in the pilot test done for the surveys (see section 5.3.3).

3.6.3 ASSUMPTIONS

Project portfolio management is assumed to be a rational decision process, but this assumption includes four other fundamental assumptions that are less frequently discussed but have great influence on research and PPM execution. Martinsuo (2013) identified the four underlying assumptions as follows:

- **Firstly,** projects primarily exist to achieve the strategic objectives of the parent organization (Artto et al., 2008). However, innovation projects are also used to question and challenge the strategy (Martinsuo, 2013).
- **Secondly,** the frameworks developed for project portfolio selection/management assume that the company controls all the resources and the projects within the portfolio compete for the same resources. This is not necessarily the case; companies collaborate with external partners and do not always have control over all the project resources (Perks, 2007).
- **Thirdly,** the organization is aware of all possible factors (internal and external) that could influence projects. With technology, markets, and industry environments continuously changing, it is hard to be fully aware of all the factors that might influence the project portfolio.
- **Fourthly,** frameworks and related research assume that the possible influencing factors on projects can be rooted into criteria and routines, which will ultimately align the projects to the strategy. However, portfolio managers are not always well informed (Cooper et al., 1997, 1999, 2000; Elonen and Artto, 2003; Joslin, 2015; Martinsuo, 2013) and the multi-project problems are not necessarily solved through criteria and routines (e.g. Engwall and Jerbrant, 2003).

3.7 PPM CHALLENGES

Using PPM practices offers many benefits, such as managing projects, allocating resources, scheduling, analysing, and governance of the projects and business (Joslin, 2015). However, companies also face challenges when using PPM. A literature review highlighted six major problem areas that organizations face when managing multi-projects or making use of PPM practices (refer to Table 14). Due to the portfolio being handled as a whole, the challenges are dependent on one another. For example, inadequate information challenges cause challenges in other areas, such as not choosing the right projects for the portfolio-level activities.

Table 14: Cited PPM challenges (in no particular order)

Problem level / area	Challenge	Sources
Project level activities	Projects lack proper implementation	Cooper et al., 2000 Elonen and Artto, 2003 Blichfeld and Eskerod, 2006
Portfolio level activities	Too many weak projects are approved; resources, value, and priority not properly considered	Cooper et al., 2001 Elonen and Artto, 2003 Engwall and Jerbrandt, 2003 António and Mandalena, 2009 Kendall and Rollins, 2003
Portfolio competencies and methods	Methods and evaluation tools to aid planning and management are inadequate	Cooper, 2007 Killen et al., 2008 António and Mandalena, 2009 Kendall and Rollins, 2003
Link to strategy	Link to strategy and strategic criteria not clearly defined	Cooper et al., 2001 Killen et al., 2008 Kendall and Rollins, 2003
Resources management	Resources are not allocated effectively; lack of consideration for smaller projects	Wheelright and Clark, 1992 Elonen and Artto, 2003 Cooper et al., 2001, 2003 Engwall and Jerbrandt, 2003 Kendall and Rollins, 2003 Blichfeldt and Eskerod, 2006 Killen et al., 2008 António and Mandalena, 2009 Pajares and López, 2014
Information management	The flow of information is inadequate and lacks usefulness	Cooper et al., 1997, 1999, 2000 Elonen and Artto, 2003 Joslin, 2015 Martinsuo, 2013

Inadequate project-level activities

Poor project management is directly linked to poor portfolio performance (Martinsuo and Lehtonen, 2007). Blichfeld and Eskerod (2006) identify the following problems management has, that hinder the success of projects: (1) the projects are not done according to plan (2) management and employees lack a broad understanding or overview of ongoing projects (3) resource allocation. According to Elonen and Artto's (2003) study, the major problems in project-level activities are the inadequate implementation of pre-project progress monitoring, and projects that are too long and complex to realistically plan them in detail.

Inadequate portfolio-level activities

Elonen and Artto (2003) identified five major problems in portfolio-level activities in their study: (1) projects were overlapping between portfolios and within individual portfolios, (2) the results of different projects were not integrated, (3) portfolio managers lack considerations when making critical decisions on projects, (4) roles and responsibilities were not clear, (5) the portfolio level gave too little feedback to the project level.

Portfolio competencies and methods

Managers perceive several mathematical portfolio evaluation techniques to be too difficult to use and generally fail to recognize the interrelationships of projects and the resources used. Historically the portfolio approaches have provided poor risk and uncertainty treatments and portfolio managers found it difficult to handle the many and interrelated criteria (Cooper, 2007). Lack of portfolio competencies are common; managers need to have a combination of skills and understandings such as the following: markets, businesses, projects, impact interdependencies, management accounting, risks, resource balancing, mathematical modelling, political skills, communication skills, and statistical and analytical skills. It is challenging to find managers that excel in all these abilities to make accurate decisions on choosing the right projects for the portfolio (Fricke and Shenhar, 2000).

Lack of links to strategy

The portfolio of projects does not always reflect the business strategy. Disconnects between spending breakdowns on projects and strategic priorities of the business exist (Cooper *et al.*, 1997). Killen et al. (2008) found that in their survey study of product (tangible product) and service providers, the need for a portfolio to reflect strategy is a common challenge; several respondents emphasized the challenges of long-term strategy and vision. Englund and Graham (1999) found that project managers' most vocal complaint is that projects appear 'randomly', that there is uncertainty about the number and scope of projects, and the projects seem not linked to the strategy. This results in employees feeling that they are working at cross-purposes, or on too many (some unnecessary) projects. In Wheelright and Clark's (1992) case study, they found that the engineers were not only focusing on non-critical work, but also spending 50% of their time on non-project-related work.

Poor portfolio management can turn to inadequate strategic criteria for project selection, which could translate to the following: projects selected have no strategic direction; projects are not strategically aligned with the organization's strategy; irrelevant projects appear in the portfolio; and unnecessary R&D spending that is not a reflection of the intended strategic priorities of the business (Cooper et al., 2001).

Resource management

Blichfeldt and Eskerod (2006) did an empirical study on 30 companies (from a diverse range of industries) that all experience resource-related problems or symptoms. Their study found that it is critical to allocate and manage resources for every project or experimental project; without monitoring and management it could lead to a shortage of resources for the entire portfolio. Many researchers regard resource allocation as one of the primary activities in PPM (Archer and Ghasemzadeh, 1999, Jonas, 2010) that should be aligned with the organization's strategy (Cooper and Edget, 2003; Martinsuo and Lehtonen, 2007; Hansen et al., 1999). Balancing resources according to skill and priority within the portfolio, is sometimes challenging. Engwall and Jerbrandt (2003) found two reasons for failure regarding resource allocation: (1) the effects of the management

accounting system could be dysfunctional for multi-project management, and (2) project managers might overstate the project priority or urgency to get better resources assigned.

Information management

The lack of transparency and quality in project information can cause problems. The management and employees are not always well informed and information is not communicated frequently enough. Sometimes there is a lack of appropriate database on project information (Elonen and Artto, 2003). The information used on the projects should determine future projects to be chosen or eliminated from the portfolio; without accurate information, the inappropriate projects could be chosen. Accurate information is hard to determine; new-product portfolio management handles future events and opportunities, which could make information uncertain and possibly unreliable (Cooper et al., 1997).

3.8 Project Portfolio Management Practices And Performances

Project management has gained attention and therefore there has also been an increase in portfolio management literature. Researchers have particularly focused on the selection processes and models that R&D project needs to consider (see Cooper, 1981, 1997, 1999). Specific project selection criteria are used with optimization algorithms or management techniques to gather, prioritize, and select projects.

Larson and Gray (2003) state that the project selection approaches can be categorized as financial and non-financial. Approaches can range from single criteria (cost-benefit) analysis to multi criteria (ranking and/or scoring) methods. The role of the criteria is not to specify projects, but to compare projects and measurably compare each project's contribution to the organizational strategy (Englund and Graham, 1999). Several studies conducted about the R&D project selection, provide a strong set of criteria for

consideration, for example market size, probability of success, strategic positioning, availability on staff, and risk.

According to Hunt and Killen (2006), PPM processes aim to improve the success of organizational projects through the allocation of resources to the most advantageous projects whilst monitoring and altering the project portfolio and resource allocations to fit the dynamic environment. Hunt and Killen (2006) state that PPM has gained momentum as companies recognize that organizational effectiveness also depends upon doing the right projects. Hunt and Killen's view correlate with PMI's (2008) definition of PPM; it is about choosing the right project rather than doing the chosen project in the right way. PPM is an ongoing decision-making process that oversees the whole monitoring and execution of existing and new projects (Cooper, Edgett, Kleinschmidt, 1998). PPM is not a specific process or method, but rather an activity that is chosen from a variety of methods and tools. Many researchers state that PPM is most effective when it is customized for each individual situation (Loch, 2000; McDonough and Spital, 2003; Phaal et al., 2006).

Although there is no single best practice, there are common elements, consistent themes, and success factors across the PPM applications. Companies could learn from 'best practice' PPM implementations in a range of project environments or industries, because of these common PPM elements that seem to transcend the industry types, portfolio level, and project type (Hunt and Killen, 2006).

3.8.1 PPM Tools

Some researchers (Dye and Pennypacker, 2000; Englund and Graham, 1999; Archer and Ghasemzadeh, 1999; Cooper et al., 2001) claimed that the project portfolio selection is important, and they have thus explored the necessary tools, techniques, and frameworks, but the clear and formal prioritization process is often not enough for the optimal success of a portfolio.

Selecting techniques and tools are helpful to evaluate quantitative and qualitative indicators for individual projects or a group of projects. These tools and techniques are

grouped into methods, or as Cooper et al. (1997) call them, 'goals'. The literature contains many discussions and debates on the methods and tools used for the selection of a project portfolio. Taylor (2006) discusses the fundamental six characteristics any model, should have, regardless of the nature of the model (numeric or nonnumeric): flexibility, realism, ease of use, capability, cost-effectiveness, and ease of computerization. Meredith and Mantel (2009) propose criteria for choosing a selection model and they suggest that the required information should be categorized under the following headings: (1) production; (2) marketing; (3) financial; (4) personnel; and (5) administrative and miscellaneous factors.

Cooper et al. (2001) discuss the popularity of the techniques, tools, models, and methods for project selection and PPM. Their results mainly show three things: first, organizations tend to use a combination of techniques, tools, and methods; second, financial methods are the most popular, but do not necessarily produce the best performing portfolios; and third, the organizations with the best performance portfolios rely more on strategic approaches than on financial methods.

Table 15 gives a summary of various studies and research on tools and methods used for portfolio management (Cooper et al., 1997a, 1997b, 2000, 2001; Archer and Ghasemzadeh, 1996, 1999; Dawidson, 2006; Armstrong and Brodie, 1994; Dyer, 1990; Çetindamar et al., 2010, Bhaskar, 2016). The key advantages and disadvantages of choosing specific methods for portfolio management goals are outlined:

Table 15: Advantages and Disadvantages of project and portfolio assessment tools (Cooper et al., 1997)

Methods Types Normally Used	Advantages	Disadvantages
Expected Commercial value (ECV)	✓ Decision tree approach quickly identifies which pathways are wise to take ✓ All projects are discounted to today and not to the launch date (penalizing projects years away from launch) ✓ ECV is largely financially based but also considers the strategic importance ✓ Recognizes the issues of constrained resources and tries to maximize the revenue in light of these constraints	× Dependent on financial and other quantitative data (data that could be unreliable or not found) × The model does not look at the balance of the portfolio (for example: high-risk versus low risk; markets and technologies balances) × The model only considers single criterion
Productivity Index		
Dynamic Rank Ordered List	✓ Multiple criteria for ranking orders concurrently without becoming complex and time-consuming ✓ It can include: strategic importance, ease and speed to do, and other desirable characteristics	× Does not consider constrained resources × Largely based on uncertain or unreliable financial data × Fails to consider the balance of projects
Scoring Models	✓ Popular to use with all four PPM objectives ✓ The attractiveness of the Go/Kill decisions at the gates ✓ Prioritization and appropriate resources allocated to the projects ✓ Can be used to ensure strategic fit ✓ Weighted Factor Scoring can increase the effectiveness of the decision making ✓ Projects can be added or deleted without re-calculating the merit of other projects ✓ Allow integration of quantitative and qualitative attributes ✓ The techniques are relatively easy to understand	× Imaginary precision is necessary for the model to work × Halo effect, if projects score high on one criterion, it tends to score high on many of the rest × Efficiency of allocation of scarce resources × Risk is not explicitly considered × Weight are required which can make things complex × Not well suited for situations where selection of one project influence the desirability of another
Comparative Approaches	Q-sort ✓ Easy to understand and use ✓ Adaptable ✓ Allow integration of qualitative and quantitative attributes.	× Difficult to use for comparing large numbers of projects × Risk is not explicitly considered × If a project is added or deleted, the entire process must be repeated
	Analytic Hierarchy Process (AHP) ✓ Structures the problems ✓ Two factors are compared at a time, allowing focus and understanding about issues ✓ Allows for the performing a sensitivity analysis ✓ Accessible and conductive to consensus building ✓ Handles quantitative factors as well as qualitative factors	× Difficult to use for comparing large numbers of projects × The procedure for ranking alternatives are arbitrary × Does not address the portfolio risk issues × Could be time consuming
Ad Hoc Approaches	Profiles ✓ Very efficient ✓ Judges projects on the same basis, given the values of particular attribute	× Very arbitrary and requires limits (that can be difficult to determine) to be set on various criteria
	Interactive selection	× May make all the projects look more alike than they are

	✓ Project managers have an incentive to make their projects look more attractive ✓ Helps managers become familiar with all aspects of the project ✓ Projects are more likely to fit the strategic objectives of the decision makers	
Risk-Reward Bubble Diagram	✓ Most popular among the bubble diagrams and simple to use ✓ Forces management to deal with the resource issue (by adding one 'bubble', you must subtract another) ✓ A good visual representation ✓ 3M's ellipses and the Monte Carlo simulation can be used to deal with the uncertainties	× Some bubble diagrams rely on financial data that could be unreliable, uncertain or not available × Maps and charts could seem to the users like an information overload × Unlike the maximization methods, the results are not in a convenient rank-ordered list, but more the starting point of the discussion × The 'right balance' of projects was unclear × Not all charts and maps are clear or get the intended message across × The charts and maps must be well thought through
Portfolio Maps Derived from Scoring Models	✓ The ease versus attractiveness chart is a very easy and useful map ✓ Has many factors that it takes into consideration	
Traditional Charts	✓ Histograms and pie charts are a useful visual representation of the portfolio balance ✓ Can address issues such as timing and cash flow ✓ Pie charts can address the spending split across project types ✓ Pie charts are also appropriate for the capturing and displaying of markets, products, and technologies ✓ Good indication of resource splits	
Portfolio Matrices	✓ Can be a useful strategic decision tool ✓ Well organized and prioritize and allocate resources ✓ Graphical representation ✓ Lead managers to make decisions that are more rational ✓ Provide information in an easy manner ✓ Provide an overall perspective of all projects	× The scope could ignore relevant strategic issues × Little theoretical or empirical support × Sometimes let users overlook basic economic principles × Lack of empirical evidence that matrices are a valuable decision aid × BCG matrix approach could interfere with profit maximizing × Limited success rate × Excessive rigidity, hinders creativity × Sensitive to the operational definitions of the dimensions, cut-off points, weighting scheme, and the specific model used
Strategic Bucket Model	✓ Helps to set spending targets ✓ The recognition that all development projects compete for the same resources can be considered (product development competes against cost reduction, both utilize R&D resources) ✓ Different criteria can be used for different types of projects ✓ Links spending to the business strategy	× This is time-consuming × This forces choices on resource splits and may be a somewhat hypothetical exercise
StratPlan or Strategic Check	✓ It uses the scoring model or financial criteria ✓ It checks to see if the resulting list of projects is actually consistent with the business's	

	strategy ✓ The method is a macro-level, strategic planning exercise and ties into new product spending and RBC's scoring model ✓ Ensures prioritization aimed in the right direction ✓ Easy to use Yes/No answers	
Benefit Contribution Models	Economic return ✓ Includes the following: Net Present Value (NPV), Internal Rate of Return (IRR), Return of Original Investment (ROI), Return on Average Investment (RAI), PayBack Period (PBP), Expected Value (EV), and Capital asset pricing model (CAPM). ✓ These techniques include time dependency consideration of investment and income flows	× IRR and PBP are not used as often
	Benefit/Cost techniques ✓ Comparisons are easy to understand ✓ Good projects are easy to identify by calculated measures	× Difficult to include non-tangible benefits × Detailed data requires for estimated cash flows
	Risk Analysis ✓ Estimates the probabilities and consequences of events occurring ✓ Models that can be used is the Monte Carlo, decision- and Bayesian statistical-theory combined, and decision theory combined with influence diagram approaches. ✓ More than one stage in the project can be considered ✓ The expected value of outcomes at each stage can be determined ✓ Good analysis to balance portfolios	× These approaches require estimates of probabilities of possible outcomes which may be difficult to determine × Bayesian approach is not universally regarded by mathematicians as valid
Optimization Models	0 – 1 Integer Programming (IP) ✓ Mathematical programming approaches maximize overall portfolio objectives ✓ Allow for interdependencies and other constraints on projects	× Don't deal with trade-offs between risk and return × Don't provide for evaluation of non-tangible benefit and cost × Could require data that isn't available × Except for stochastic programming, normally they cannot include risk considerations × Except for goal programming, they don't handle multiple criteria × May give false sense of accuracy × Assumption of 'additivity' which does not consider the interrelation among the projects
	0-1 Integer Linear Programming (ILP) ✓ Allow for a multitude of different combinations of candidate projects ✓ Structured and understandable ✓ Allow for sensitivity analysis ✓ Handles interdependencies among projects, and mutually exclusive projects	× Does not handle political or social issues (qualitative factors) × Does not take uncertainty or risk into consideration × The solution methods developed thus far are not applicable to large problems

	✓ Ongoing and mandatory projects can be considered ✓ Considers resource limitations throughout the entire planning period and/or individual periods	
Resource Demand Created by Active Projects	✓ Recognizes if the right resources to handle the projects are available ✓ This method identifies if there are sufficient resources for the projects ✓ The results can show which department or group is the constraining one	
Resource Demand Generated by Business's New Product Goals	✓ Can find a gap between demand versus capacity ✓ Helps prioritization and pruning efforts ✓ Causes managers to rethink their arbitrary new product revenue and the profit goals set for the business ✓ Identifies functional areas that are major bottlenecks in the innovation process (decisions to increase of shift certain personnel)	× Cannot be used on its own, makes use of the scoring model × Time consuming
Road Maps	✓ Link strategy to product or technology plans ✓ Focus on long term planning ✓ Improve communication ✓ Focus on highest priority topics ✓ Various roadmaps to choose from (e.g. product planning, strategic planning, program planning, process planning, integration planning) ✓ Wide range of aims to which it can contribute ✓ Time frame can cover the past and future ✓ Can easily be adapted to fit a particular application ✓ Flexible process to develop roadmap ✓ Flexible graphical format to present information of roadmap	× Can become complex × Gaps in available knowledge could lead to uncertainty × Sometimes difficult to implement × Requires ongoing maintenance

Despite the variety in techniques, tools, and approaches, it is important to pay close and continuous attention to the project interactions, such as the competitions for resources and the time-dependent nature of the projects (António and Mandalena, 2009).

Cooper et al (1997) did a study to determine which assessment tools are the most popular to achieve the three main objectives of PPM (the fourth objective was only included in Cooper et al.'s later research). Table 16 below shows a short summary:

Table 16: Most popular assessment tools according to Cooper et al. (1997).

Objective	Most popular assessment tools and methods related to objective
Value Maximization	Expected Commercial Value (ECV); Scoring Models; Productivity Index (PI)
Balance	Bubble diagrams; visual models; most popular dimensions: risk vs. reward, ease vs. attractiveness, and breakdown by market, project type, and product line
Strategic direction	Scoring model, strategic buckets, strategic check

3.8.2 Project Portfolio Selection Process and Frameworks

The literature reveals that more than one hundred techniques and tools support an organization in selecting projects for its portfolio (Dos Santos, 1989; Archer and Ghasemzadeh, 1999). Each tool has its own advantages and disadvantages, making it necessary for organizations to apply a variety of tools and techniques (Cooper et al., 2001; Archer and Ghasemzadeh, 1999). This requires organizations to adapt or develop a logical framework or process through which the necessary tools and techniques are integrated and selected to support the organization's project portfolio selection. To be effective in project portfolio management, an appropriate framework must be chosen to evaluate project proposals and to select a project portfolio that is best aligned with the corporate strategy (Archer and Ghasemzedeh, 1999).

In recent literature focus has shifted to the approaches rather than the tools and techniques. Common principles from these approaches are to first divide the project's proposals into subsets (Englund and Graham, 1999; Sommer, 1999; Cooper et al., 2001)

where each subset will be a group of projects which share the same strategic bucket (Cooper et al., 2001), or different categories or projects with similar characteristics (Crawford et al., 2006). This is an important step in the organization to ensure that the balance of the project portfolio is achieved through effectively comparing project proposals by the same criteria, tools, and techniques.

This study will discuss some of the most widely cited frameworks. Table 17 below shows summaries of the frameworks and their main related contributions to the PPM practice.

Table 17: Summary of authors' contributions to this study.

#	Author	Main related contribution summarized
1	Jonas (2010)	Summarized the tasks and role of portfolio managers into four phases.
2	Koen (2005)	Provides an overview of the overall approaches and organizational architecture for innovation in large companies.
3a	Cooper et al. (2009)	Creating 'Stage-gate' which is a roadmap for moving NDP projects from idea to launch. Widely used model for PPM definition, by dividing it into three main categories.
3b	Cooper and Edgett (2005)	Proposed six major steps for a product innovation strategy as a basis for the ideal logical flow or 'thought process'.
4	Englund and Graham (1999)	Designed steps for upper management, for more successful projects that are effectively linked to the organization's strategy.
5	Archer and Grasemzadeh (1999)	Presented an integrated framework with suggested tools and techniques for the project selection process.
6	Patterson (2005)	Proposed a portfolio planning and management framework that includes new product portfolio activities as well as other related efforts.
7	Ottum (2005)	Proposes tools and techniques that are useful for quantitative market research. Based on Cooper's Stage-Gate NPD process.

(1) Jonas (2010) – the role of the project portfolio manager

Jonas (2010) summarized the tasks that portfolio managers are involved in into four phases of PPM. Although PPM research is gaining interest, there is still a lack of research regarding the role of the project portfolio manager (Blomquist and Müller, 2006).

The first phase *(portfolio structuring)* defines the target portfolio that is derived from the corporate strategy. This phase includes evaluation of projects and proposals, prioritization, and selection that should be aligned with the strategic plan (Meskendahl,

2010; Archer and Ghasemzadeh, 2004). PPM is also a means for senior management to define the market, products, and technologies to operationalize the business strategy (Cooper et al., 1999). It is important to have high information quality and transparency to increase the chances of project portfolio success (Cooper et al., 2001).

The second phase *(resource allocation)* handles portfolio related issues only (Jonas, 2010). This phase aims for optimal utilization of resources, which is one of the major challenges in PPM literature (Elonen and Artto, 2003; Cooper et al., 2001, 2003; Blichfeldt and Eskerod, 2006; Killen et al., 2008; António and Mandalena, 2009; Pajares and López, 2014). Resource management includes the following: cross-project resource planning, conflict management, formal resource approval, and resource re-allocation to react to short-term change requests (Jonas, 2010). The portfolio-structuring phase is closely linked to this phase by providing initial resource allocation, but this must be continuously reallocated and managed.

The third phase *(portfolio steering)* is a continuous management of tasks to coordinate the projects in the portfolio (Müller et al., 2008). This phase includes the following: monitoring the portfolio's strategic alignment, developing corrective actions of the portfolio if the portfolio deviates from the intended target, identifying the synergies within the portfolio, and coordinating projects across business lines (Jonas, 2010). These capabilities, and the PPM practices, depend on the availability of information to management (Kopmann et al., 2014).

The last phase *(organizational learning and portfolio exploitation)* addresses the following activities that are at the end of the project's life cycle: portfolio exploitation, organizational learning, and securing project success. The fourth phase includes the following: project results evaluation, post-project reviews, maintain and store relevant knowledge at project closure, and utilize the lessons learned from earlier projects (Jonas, 2010). Post-project evaluation and development of lessons learned contribute to the advancement of project management practices and ultimately to the success of projects (Anbari et al., 2008; Koners and Goffin, 2007).

(2) Framework of Peter Koen

Koen gives an overview of the general approaches and organizational design for innovation in large organizations. The focus of innovation can be internal or external. Figure 11 below explains the divisions.

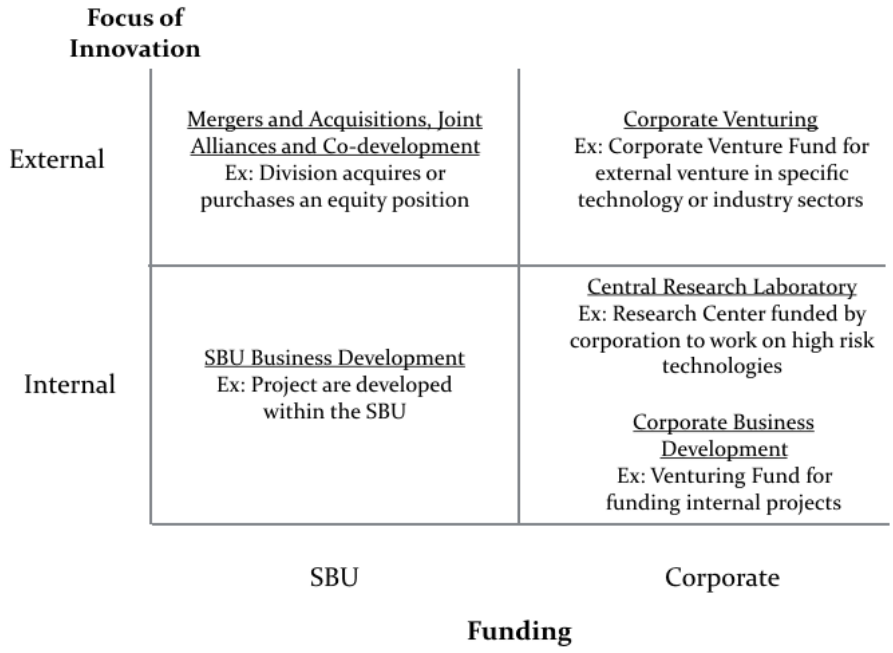


Figure 11: Overall typology of corporate organizational structure where innovation may occur, adapted from Koen (2005)

The study done by Koen refers to internal innovation funded from the strategic business unit (SBU) and it is very relevant to this study. Portfolio managers need to decide with which projects they are going to continue and which projects they are going to cut.

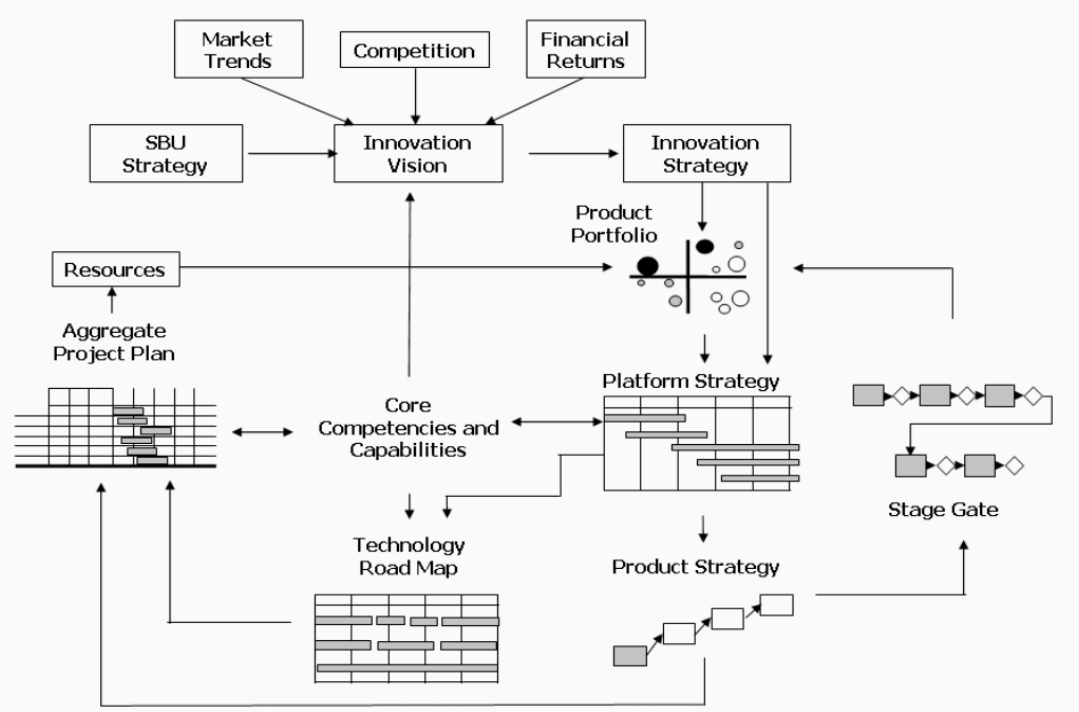


Figure 12: Overall product development architecture that exists within a Strategic Business Unit (Koen, 2005)

INNOVATION VISION

Five forces bind the innovation vision as seen in Figure 12:

1. Overall SBU strategy – defines overall strategy through the value chain, mission, and market channels of the SBU.
2. Core competencies and capabilities – core competencies and capabilities create a competitive advantage, for example if the competencies or capabilities are valuable, rare, immutable, and non-substitutable
3. Market trend – the innovation visions must meet the requirements for the current and predicted future market trends.
4. Competitive forces – the competitive environment must be studied to gain a competitive advantage, for example being up to date with the competitors' intellectual property.
5. Financial or economic goals – the innovation vision should reflect the revenue growth and profitability goals aimed to achieve certain targets within the investment parameters.

INNOVATION STRATEGY PORTFOLIO

The innovation strategy states the services or products needed to achieve the innovation vision. The strategy is operationalized into a product portfolio that senior management takes on by determining project selection and resource allocation. The four portfolio goals set out by Cooper et al. (2001) can be used as a guideline for the selection process (refer to section 3.10.1.).

PLATFORM AND PRODUCT STRATEGY

Platform products determine a basic structure for the next generation of products or processes. The platform strategy controls and evaluates the core competencies and capabilities to define the overall combined project plan and resource requirements. The information is compared alongside the innovation strategy resource needs, and then modified to match the platform, portfolio, and product strategies.

> *Companies that develop platforms built on the core competencies and capabilities of the firm typically achieve a greater return from their investment than those that primarily focus on incremental products built on continuing extensions of their existing products* – Peter A. Koen

STAGE-GATE AND TECHNOLOGY ROAD MAP

To manage individual projects a Stage-Gate approach is typically used. Each project is assessed at each gate and compared to other projects. Likewise, technology mapping is critical to product development architecture, providing a road map for the direction in which the organization wishes to go. Technology is related to time and directly connected to product strategy.

CONSTITUENCIES FOR MANAGING THE PROCESS

Koen (2005) identifies five constituencies that manage the overall process:

1. Senior management – responsible for determining the innovation vision, product and platform strategy, and utilizes the portfolio to be aligned with the organization's strategy.

2. R&D management – both corporate and SBU – research laboratories are responsible for technology roadmap, licensing, developing, and acquiring technologies.
3. Process owner – facilitates and mentors teams to ensure processes are run efficiently.
4. Portfolio manager – responsible to keep information on multiple projects up to date and accurate.
5. Product line planning team – reports to senior management regarding the plan and future platforms, by collecting the company's capabilities, competencies, customary architectures, and customers' needs and future movements for the next platform.

(3a) Framework of Cooper and Edgett

Cooper and Edgett (2009) proposed a framework which views portfolio management and resource allocation as a hierarchical process that consists of two levels of decision-making, as displayed in Figure 13. The first level is strategic portfolio decisions, such as strategic product roadmaps and strategic buckets. This level balances the portfolio and aligns it with the corporate strategy by organizing the proposed projects into subsets and categories. The lower level is referred to as the tactical portfolio decisions. This level follows the strategic decisions and practices of the project selection process that uses different tools and techniques to prioritize projects and allocate resources appropriately. The Stage-Gate process is suggested by Cooper et al. (2000) to compliment the PPM and determines if any resources are released from existing projects. The Stage-Gate process is highly suitable for R&D and NPD projects.

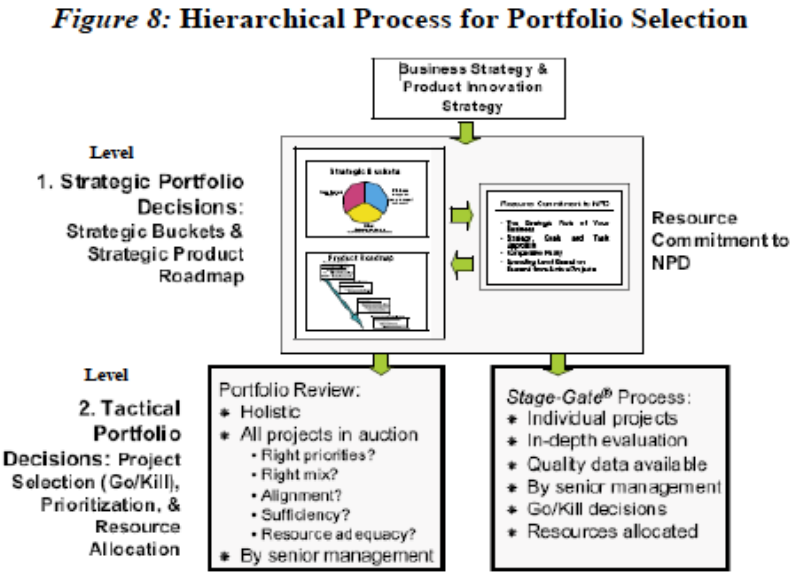


Figure 13: Hierarchical Process for Portfolio Selection (Cooper, 2005)

Table 18 is a summary of Cooper's (2009) stages, the purpose of each stage, and the suggested methods for each stage.

Table 18: Cooper's (2009) stages summarized as a stage purpose and suggested methods.

Stage	Stage 1 Scoping	Stage 2 Build Business Case	Stage 3 Development	Stage 4 Testing and validation	Stage 5 Launch
Stage purpose	• Quick investigation of project • Determine objectives, technical and marketplace merits • Little or no primary research done at this stage	• Detailed investigation	• Actual design and development of product (prototype) • Implementation of the development plan	• Verifying and validating the proposed product in the market and production • Tests the entire viability of the project • Financial justification prior full launch	• Full commercialization of product • Post launch plan implemented
Suggested methods	• Preliminary markets • Technical assessment • Business assessment	• Market analysis • Competitive benchmarking • Concept testing • Technical assessment • Source of supply assessment • Financial and business analysis	• Lab tests • In-house tests • Alpha tests	• Customer tests • Beta test • Field trials • Production process via trial or limited production runs • Customer acceptance by way of test market or trial sell • Financial analysis	• Monitoring and fixing

(3b) Six steps formed by Cooper and Edgett for a product innovation strategy

ELEMENTS OF A PRODUCT INNOVATION STRATEGY AND THEIR IMPACTS

Cooper and Edgett (2009) found six elements of product innovation that distinguish the topmost performing businesses. Figure 14 below is a summary of the steps to create a product innovation strategy for the organization.

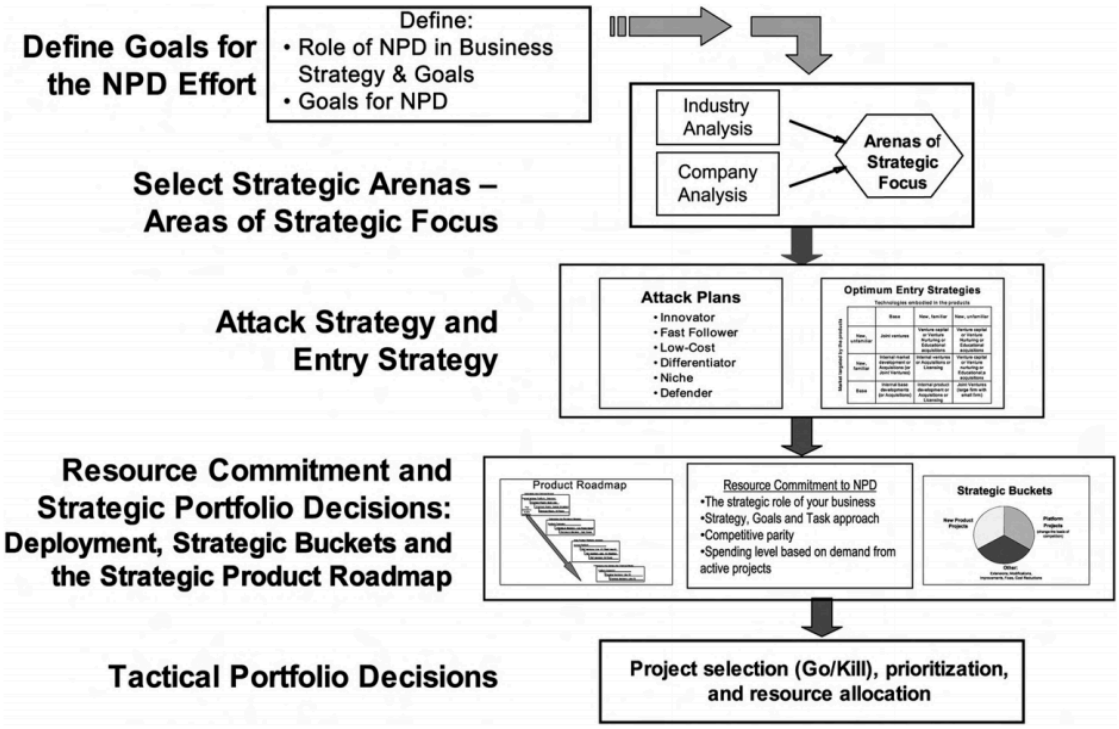


Figure 2.—This framework for developing a product innovation and technology strategy begins with product innovation goals at the top and moves through to tactical project selection decisions at the bottom.

Figure 14: Product innovation and technology strategy, Cooper and Edgett (2010)

These elements are explained in more detail as follows:

(1) **Objectives and Role:** The business's product innovation strategy states the objectives of new product efforts, and the part it plays in achieving the goals of the business. Having clear objectives and sub-objectives are mandatory. Another key factor is the level of communication for the proposed objectives. It is easier when all personnel are working towards a common goal. The study done reflected that

46.3% of businesses define and link the role of product innovation to realize their business goals. However, this role is defined by 58.6% of the top performers but only 30.8% of the worst performers according to the survey. The element of innovation strategy is correlated best with new product performance.

(2) **Arenas and Strategic Thrusts:** It is vital to focus an effective product innovation strategy, identifying where to attack and where not to. Strategic arenas include industry sectors, markets, applications, technologies or product types. Without outlined arenas, the search for specific new ideas, products, and opportunities, are unclear. Over time, the portfolio will be made up of products, markets, technologies, or product-types that are scattered. An example would be to first assess the market pull and the opportunities for leveraging the business's core competencies and select arenas to focus the new initiatives. Patterson (2005) identified information of interest for the assessment: factors correlated to emerging markets; state and actions of competing firms; global, national, and local business conditions and trends; environments and trends in current markets; the trends of related technologies; and emerging technologies that might be of interest in the future.

(3) Attack Strategy and Entry Strategy: The strategy to enter each strategic arena should be part of the product innovation strategy. For example, if the business is first to market or fast follower, the strategy may require an aggressive approach. Other strategies focus on low cost versus a differentiator versus a niche player. When planning to enter a new arena, there are also other factors to consider: licensing, joint venturing, partnering, product development alliances and even mergers and acquisitions (M&A) of other firms.

(4) Deployment – Spending Commitment, Priorities, and Strategic Buckets: Product innovation strategy must delegate resources and indicate emphasis, or strategic priorities, according to each strategic arena (knowing where to focus efforts). Methods such as the strategic bucket help to ensure the strategic alignment of product innovation with the business goals.

(5) **Strategic Product Roadmap – Major Initiatives and Platform Developments:** A strategic roadmap is a way businesses map out major initiatives in attack plans. It is the management's view of how to complete their objectives (Albright and Kappel, 2003). The product innovation strategy therefore, should map out main new product initiatives and their timing that is needed to succeed in the selected market sectors. The strategic product roadmap may specify a platform for advances required, or acquisition of new technologies may be laid out in the form of a technology roadmap.

(6) **Tactical Individual Project Selection:** Once the above strategy steps are completed, management can handle decision-making. Typical questions asked are: What specific product project should be undertaken? What and how many resources should be allocated to each project? What are the priorities? This is necessary to know what projects have a 'Go' or which have a 'No Go'.

(4) Framework of Englund and Graham (1999)

Englund and Graham (1999) use a systematic approach of 'mental decision process' for portfolio selection. This is a four-step approach that requires important input from management teams to make decisions on projects and resource control. It is not necessary to hold the same criteria across all categories of the project; Englund and Graham (1999) state that some teams found varying criteria for different categories of the projects were more effective. The weighting of the criteria should be adjusted as the projects move through the life cycles. Outputs from the four steps interconnect in a true systems approach. The four-step approach is described as follows:

(1) What should the organization do - people, categories, goals, and criteria
(2) What can the organization do - list projects, requirements, capacity and critical few
(3) Analyse and decide on projects – desired mix, prioritized list, decision and in-plan
(4) Implement the plan – use, communicate, fully fund, update

Table 19 is a summary of Englund and Graham's (1999) stages, the purpose of each stage, and the suggested methods for each stage.

Table 19: Englund and Graham's (1999) framework summarized as stage purpose and suggested methods for each stage.

Stage	What should be done	What can be done	Analyse and decide	Implement Plan
Stage purpose	• Overview of projects • Purpose, vision and mission • Clarity of strategy or goals • Categorize projects • Evaluate market segments	• Gather data on all projects • Re-examine markets such as: customer needs, future trends, commercial opportunities, and new markets • Constantly introduce more screening criteria. Eliminate or scale projects down that use excessive resources • Involve customers in discussions	• Compare estimated resource requirements with available resources • Keep in mind the stage of the project when comparing • Decide upon a diversified mixture of project and include experimental projects if there are any selected	• Upper management needs to enforce the plan • The plan is a strategic guideline, but must be adapted if need be
Suggested methods	• Bubble diagrams axes – extent of product change vs. the extent of process change (suggested by Wheelwright and Clark) • Strategic buckets • Scoring models – scoring criteria can vary from project contribution to numerical scores • Rank criteria according to importance	• Activity-based costing models instead of traditional models • Save time by identifying must-do projects or simple go/no-go decisions • Test proposals with organization's strategic goals before focusing on technology or financial factors • Statistical projections or simulations - estimate the time and resources required for each project • Reconcile this data with top-down project goals • Identify resource capacity inside and outside the organization • Balance projects with non-project work by using realistic numbers for resource availability	•Spreadsheets are useful to depict allocation of resources according to priority •Qualitative analysis considering the following: cost of committing short-term, opportunistic, poorly conceived projects, and potentially strategically better fit projects •Focus on project benefits before cost •Analytical hierarchy process (AHP) is useful to compare projects according to agreed-upon criteria and structure complex situations •Plan of record (POR) is useful to keep track of total list of projects	•Simplified hierarchy is useful to prioritize projects •Management skills

(5) Framework of Archer and Ghasemzadeh (1999)

As with the Stage-Gate model that Cooper et al. (2000) use, Ghasemzadeh et al. (1999) also propose prequalification of each project before moving on to the next step or stage of the selection process. This eliminates bad proposals by narrowing the choice down to necessary projects.

Archer and Ghasemzadeh (1999) developed a framework, that is widely used and referred to in the literature and that is a logical series of activities. They did extensive research on project portfolio selection tools and techniques by developing a framework that divides the work into stages. Each stage accomplishes certain objectives that are used in the next stage, but the model must be adapted to the requirements of the organization. Once the strategic focus of the organization has been established, it should not undertake any radical changes in the project selection process. The culture should be taken into consideration when the organization is selecting the methodology (Archer and Ghasemzadeh, 1998).

This framework is a logical series of activities requiring full involvement by the selection committee (see Figure 15). The framework has phases:

(1) **Strategic considerations:** These help to determine the overall budget allocation for the portfolio and strategic focus; consider the external (market) environment and the internal (strengths and weaknesses) environment; and develop a strategy.
(2) **Individual project evaluation:** The projects are measured individually, evaluating the benefits, and valuing each project that contributes to the portfolio.
(3) **Portfolio selection:** This phase deals with the selection of portfolios based on project parameters. This includes the relations of projects and resource constraints and independencies.

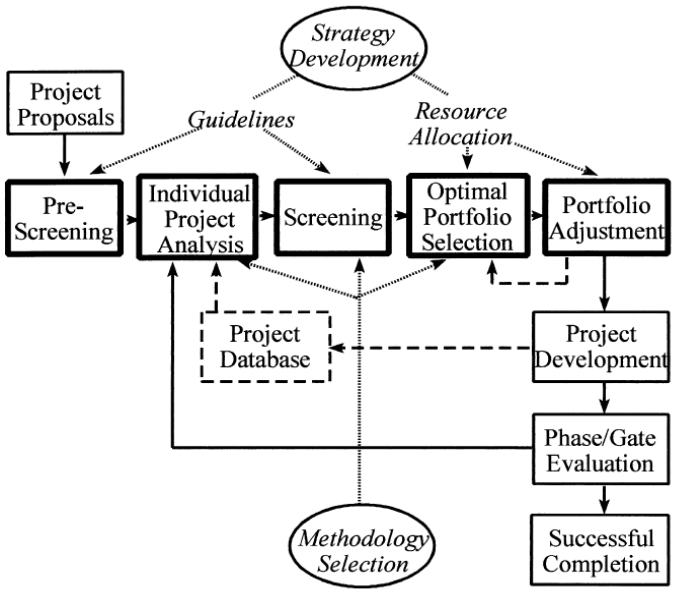


Figure 15: Framework for Portfolio Selection (Archer and Ghasemzadeh, 1999)

Preprocess

METHODOLOGY SELECTION

Methodology selection should be selected before any other activities in portfolio selection have taken place. The methodology selection should be flexible and it should have possible changes where need be. Each stage involves choices to modify the evaluation to suit the organization. The organization's culture, problem-solving style, and project environment, will depend on previous experiences. Common measures (e.g. NPV, risk, scoring attributes) are used for an equitable evaluation of the projects (Archer and Ghasemzadeh, 2004).

STRATEGY DEVELOPMENT

Strategic decisions about portfolio focus must be taken into consideration, such as the overall budget constraints which include internal and external business factors. The strategic implications are complex and they are different in each situation; factors such as the market place, strengths, weaknesses, opportunities and threats should be evaluated.

The front-end planning process is frequently done below par (Khurana and Rosenthal, 1997; Archer and Ghasemzadeh, 2004). However, Cooper et al. (2001) suggest project

portfolio matrices and graphs respectively, as useful tools to evaluate the firm's strategic position. The overall resource allocations must be made to each category.

Process Phase

PRESCREENING

This stage ensures that the projects being considered for selection, are in line with the strategic focus and possibly a portfolio fit. The projects that were done in advance, should have had a feasibility analysis and estimated parameters to assess the projects, as well as being classified according to criteria. Mandatory projects must be included in the analysis, and elimination of unfit projects must be done to narrow down the number of projects under consideration.

INDIVIDUAL PROJECT ANALYSIS

Projects are examined individually to determine the impact of the project. Project risk, NPW, ROI, market research, scoring benefit contribution, checklists, and other calculations are also useful. The major output (qualitative and/or quantitative) at this stage is a common set of parameter estimates for each project that are under consideration (Archer and Ghasemzadeh, 2004).

SCREENING

Here the project attribute results from previous stages help eliminate interconnected families of projects or individual projects that do not meet the criteria. Archer and Ghasemzadeh (2004) use Lieb's (1998) model that analyses research and development in a two-stage process, aimed to reduce uncertainty. Research projects require technical, business and marketing evaluations. Lieb suggests that the development success of the number of research projects, depends on the cost-effectiveness of research work and the ability of the organization to support the development efforts.

OPTIMAL PORTFOLIO SELECTION

Optimization is tested and performed at this stage; relations among various projects are measured, resources competition, including interdependencies, and timing, with the parameters of each project established at the previous stage. Portfolio matrices, scoring

models, and AHP are common among decision makers at this stage, allowing for a range of qualitative and quantitative overviews. However, these techniques fail to consider multiple resource constraints and project interdependencies and thus a Q-sort has been suggested. This stage is a two-step process: (1) relative total benefits are determined for each project, (2) relationships and constraints among projects must be considered (Verma and Sinha, 2002).

PORTFOLIO ADJUSTMENT

This stage needs to give an overview of important characteristics and constraints; this can be displayed using matrix-type displays, alongside any suggested variations on resources or selected projects (Cooper et al., 2001). Decision makers should not have too many numbers displayed that may cause confusion, and adjustments to portfolio parameters must be made if necessary, at this stage. There are a number of ways in which portfolio balance can be achieved. The balance is important and should be evaluated with care. Archer and Ghasemzadeh agree with Cooper et al. (2001) that in NPD portfolios, balancing portfolios is second in importance to having the right number of projects.

Post-Process Phase

PROJECT DEVELOPMENT AND PROJECT EVALUATION

This stage should collect data that is later valuable for future portfolio selection exercises. This allows for a better evaluation of the following: new projects, existing projects, possible changes in strategic focus, revision in available resources, and changes in environment.

Table 20 is a summary of Archer and Ghasemzadeh's framework, the purpose of each stage, and the suggested methods for each stage.

Table 20: Summary of the portfolio selection framework obtained from Archer and Ghasemzadeh (2004)

Stage	Methodology selection, strategy development	Pre-screening	Individual Project Analysis	Screening	Optimal Portfolio Selection	Portfolio Adjustment	Final portfolio
Stage Purpose	Choice of modelling techniques, development of strategic focus, budgeting, resource constraints	Rejection of projects that do not meet portfolio criteria	Calculations of common parameters for each project	Rejecting non-viable projects	Integrated consideration of project attributes, resource constraints, interactions	User-directed adjustments	Project development
Suggested methods	Business strategy correlation and allocation, cluster analysis, etc.	Manually applied criteria; strategic focus, champion, feasibility study availability	Decision trees, risk est., NPV, ROI, resources requirements etc.	Ad hoc techniques	AHP, constrained option, scoring models, sensitivity analysis	Matrix displays Sensitivity analysis	Project management techniques, data collection

(6) Framework by Patterson

According to Patterson (1999), an effective new product program is essentially a system for rapidly gathering and assimilating information that systematically adds value until enough information is collected to describe how to make, sell, and support an existing new product. Figure 16 below is a framework for portfolio planning and management. This framework includes new product portfolio activities (inside the dashed lines), as well as support functions and other related efforts (outside the dashed line). The business leadership team is concerned with strategic processes (portfolio planning) and several other tactical tasks for portfolio work including portfolio assessment, resource management, and portfolio review.

FIGURE 3.1 PORTFOLIO PLANNING & MANAGEMENT WITH RELATED ACTIVITIES.

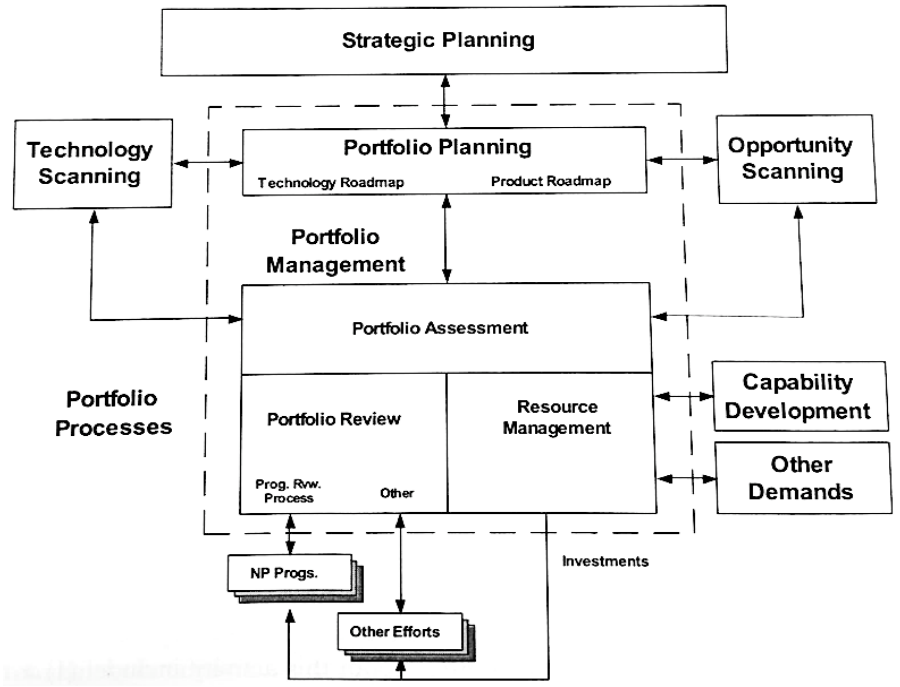


Figure 16: Portfolio Planning and Management with Related Activities (Patterson, 2005)

Objectives

The overarching objective is to transform the business strategy into effective and specific new product investments. These investments must be aimed to produce profitable and suitable business opportunities, which involve competitive and possibly newly emerging technologies and practices.

The second overall objective is to provide strategic guidance to the various capability development activities. The activities may include hiring new employees, training and development for the existing work force, gaining new tools, adding new manufacturing abilities, developing new business processes, or forming new strategic partnerships. The second objective is to keep the company sustainable and focused over time.

Portfolio Planning

Refers to the set of R&D projects, technology, and new product efforts that are currently funded or underway. The portfolio planning must be reviewed and approved periodically.

INFORMATION OF INTEREST

Each portfolio planning process needs to gather and analyse internal and external information, related to technologies and markets of importance to the organization. The following are some information of interest:

(1) Market environment and trends
(2) Factors related to the emerging markets
(3) The competitive environment, state and actions of competitors
(4) Global, national, and local business conditions and trends
(5) Trends and other factors related to technologies of current interest
(6) Emerging technologies and technical trend that could influence or interest the organization

INTEGRATED MARKET

An important part of most portfolio planning processes is the integration of market and technology perspectives. The marketing functions will normally be primarily responsible for the product roadmap and the R&D function that is responsible for the technology roadmap. However, at various points in the process, these two functions should integrate and share gained knowledge, which makes the roadmaps responsive to any new information.

Portfolio management

Portfolio management is a set of activities; some of the activities include portfolio assessment, resource management, and portfolio review. The primary objectives of portfolio assessment are to ensure that some of the following steps are made on the investments: provide anticipated returns, move the firm into the strategic direction, continuously evaluate best possible use of resources. A constant comparison between portfolios must be made to ensure that a possible alternative investment action is not neglected.

7) Suggested tools for market research by Ottum

Ottum (2005) gives an overview of some of the most useful tools when performing quantitative market research for initial NPD stages. In the early stages of NPD, there are important questions to answer that are critical for market research. Ottum presented a few of the critical questions for market research and he applied it to the traditional Stage-Gate concept created by Cooper (1986) for a NPD process. The 'Fuzzy Front End' first stage of NDP is discovery and it is important to have the right set of tools to get an understanding about the market. Segmentation is useful in the beginning as a qualitative tool, but so is perceptual mapping as a quantifying tool.

Table 21 is a summary of Ottum's (2005) stages, the purpose of each stage, and the suggested methods for each stage.

Table 21: Ottum's (2005) suggestions summarized as stage purpose and suggested methods.

Stage	Gate 1	Stage 1 Scoping	Gate 2	Stage 2 Build Business Case	Gate 3	Stage 3 Development	Gate 4	Stage 4 Testing and validation	Gate 5	Stage 5 Launch
Stage purpose (Questions)	• Which customers to target • What the customers think of the current products • Which customer needs should be targeted for new product ideas • Analyse which of the raw ideas are the most promising to pursue • Find the optimal mix of features and price				• Find the best fit specifications for the new product • Analyse the feedback of the prototype • Determine who will buy the product and where the sales will come from • How many needs to be sold to make money				• Post launch plan implementation	
Suggested methods	• Segmentation • Perception Mapping • Kano Method and Needs Ranking • Concept Testing • Conjoint Analysis				• Quality function deployment • Product use testing • Beta testing • Extended use testing • Discrete choice modelling • Source of volume analysis • Simulated test market • Trial sales • Test market					

Success

For a long time researchers have tried to identify the factors that influence the success of a project. This has led to a list of variables – yet no general consensus has been reached. The broad meaning of success is to meet or exceed expectations and goals. Each project is different and has different goals that need to be met, as the way success is measured, is most likely different for every project. 'Project success factors are also very useful for analysing why projects are a success or a failure but cannot be used for measuring the degree of success'- Anton de Wit (1988). The ambiguity and lack of empirical evidence on success and failure has provoked many criticism and debates. The managerial focus of firms has shifted towards the effective link of management of project portfolios and the overall business purpose (Artto and Dietrich, 2004; Dietrich and Lehtonen, 2005). Figure 17 is the process that was followed to answer the questions in Table 22 that are addressed in this chapter.

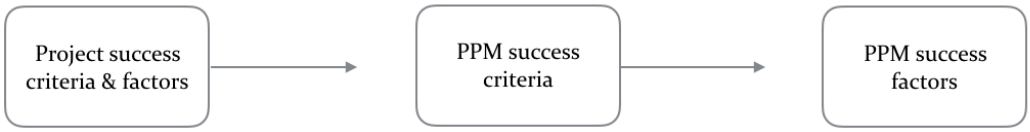


Figure 17: Steps followed to address the questions for this section

Table 22: The main questions and where it is addressed in the section of Success

This section aims to answer the following main questions		Sections where questions are addressed
1	What are a project's success criteria and factors?	3.9 Project success criteria & factors
2	What are the different PPM success criteria in literature?	3.10.1 PPM success criteria
3	Which are the six mostly used or mentioned PPM success criteria according to literature?	3.10.2 PPM success criteria
4	What are the PPM factor categories chosen for this study?	3.10.3 PPM success factors
5	What are the factors of best practice for PPM?	3.10.3 PPM success factors

3.9 PROJECT SUCCESS, CRITERIA, AND FACTORS

By definition, a portfolio in this context is '*a range of investments held by a person or organization*' or "*a range of products or services offered by an organization*' (Oxford, 2016). Thus, a portfolio is a collection of projects. Using this logic, one can assume that the success of projects can possibly contribute to the success of a portfolio.

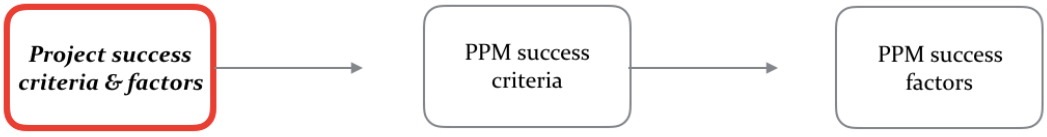
Martinsuo and Lehtonen (2006) found that single-project management is linked with portfolio management efficiency; single-project factors such as decision making, goal setting, and information availability are related to portfolio management efficiency. This section explores the success criteria and factors of projects.

3.9.1 SUCCESS CRITERIA AND SUCCESS FACTORS

Research on success criteria and critical success factors (CSFs) differ, due to variables such as project complexity, scope, and uniqueness (Waterigde, 1998). However, making a distinction between project success criteria and project success factors, has gained more attention (Westerveld, 2002). Research on project success shows that there is no single general checklist of project success criteria suitable for all projects; success criteria will vary due to issues such as size, uniqueness, and complexity (Wateridge, 1998). The articles used are from different fields of study such as construction, information technologies, communications, and general research.

This study takes the stance that success, from a strategic perspective, is dependent on the organization's ability to implement the desired process or action.

3.9.2 PROJECT SUCCESS AND PROJECT MANAGEMENT



Morgan et al. (2007) state that senior management needs to understand and engage in project management for strategic development to take place. De Wit (1988) states that it is

essential for a distinction to be made between project success and the success of project management (PM). Hubbard (1990) believes that the action taken by the management of project (PM) actions, is key for project success. Munns and Bjeirmi (1996) concluded that PM techniques will only contribute to the success of projects, but to achieve success beyond that of only the projects, the right projects must be selected; recommending the selection process of projects at screening stages must be a primary focus.

Project management

Project management (PM) offers organizations the means to be effective, efficient, and gain competitive advantage in a complex and irregular environment (Ika, 2009; Jugdev and Müller, 2005). Given the nature of PM, it is widely recognized that PM needs its own set of tools and techniques (Munns and Bjeirmi, 1996). Belassi and Tukel, (1996) state that the improvement of scheduling techniques would lead to better PM and it would result in project success. Wateridge (1995) on the other hand, recognizes the tireless efforts of practitioners to implement the scientific activities of PM, but still projects' results continue to disappoint stakeholders. Turner (1999) states that PM is 'about managing people to deliver the results, not managing work'. To define the project management, project success must be defined first. What result does the company aim for when applying project management practices?

Project Success

With the increase in people working in an environment where program and portfolio practice is used, there is an increase in need for a clear understanding of how project success is defined, because program and portfolio success total project success (Jugdev and Müller, 2005). Literature on PPM encourages evaluating, prioritizing and selecting projects that are based on strategy (Martinsuo and Lehtonen, 2005). PMI (2008) identifies a common goal among the understanding of PPM; PPM must ensure that an organization is choosing the right projects, rather than doing the chosen projects in the right way. This is related to the understanding of how some authors define the concept of project success through effectiveness and efficiency. Efficiency means doing things right and effectiveness means to do the right things (Ika, 2009; Jugdev and Müller, 2005); both are goal-orientated practices that relate to achieving success (Belout, 1998). However, efficiency

metrics are easier and quicker to grasp than effectiveness measures (Jugdev and Müller, 2005).

Constantino et al. (2015) make a distinction between project success and project management success in the same way: 'project success is next to the idea of effectiveness (achieved vs. targeted objectives), while project management success is next to the idea of efficiency (consumed resources vs. achieved targets)'. Quality improvement tools and techniques in PM could help achieve effectiveness. The success of a project corresponds to the efficiency and effectiveness of a project (Belout, 1998).

Project success in literature has long been considered to fall under three constraints – time, cost, and quality. These constraints are otherwise known as the 'time/cost/quality triangle', the 'golden triangle', or the 'iron triangle' (Atkinson, 1999; Westerveld, 2003). Nonetheless, these constraints are not necessarily sufficient; some projects have often delivered within the time, cost, and quality but have still been considered failures (Ika, 2009). An example of this is the Ford Taurus car (1995) that was completed on time but still turned out to be a failure (Shenhar et al., 2005).

The concept of project success remains broad and ambiguous, but literature still emphasizes the importance of project success criteria and critical success factors (CSFs) (Ika, 2009). Ika (2009) studied and analysed 30 articles about success criteria and factors to show how the definitions changed over time. Table 23 shows how success criteria, success factors, and emphasis changed over time.

Table 23: Measuring success over time (Ika, 2009)

Research Focus	Period 1 1960s – 1980s	Period 2 1980s – 2000s	Period 3 21st Century
Success criteria	"Iron triangle" (time, cost, quality)	Iron triangle Client satisfaction Benefits to organization (org) End-user's satisfaction Benefits to stakeholders Benefits to project personnel	Iron Triangle Strategic objectives of client organizations and business success End-user's satisfaction Benefits to stakeholders Benefits to project personnel and symbolic and rhetoric evaluations of success and failure
Success factors	Anecdotic lists	CSF lists and frameworks	More inclusive CFS framework and symbolic and rhetoric success factors
Emphasis	Project management success	Project/product success	Project/product, portfolio, and program success and narratives of success and failure

Project Success Criteria

Generally, the two categories that project success research fall under are either project success criteria, or examining critical success factors. Some studies see it as two distinct concepts and even tried to find the links between the two (Westerveld, 2002), while other discussions have blurred the lines of distinction and taken the two as synonyms (Lim and Mohamed, 1999). The Oxford Dictionary defines criterion as 'a principle or standard by which something may be judged or decided', while a factor is defined as a 'circumstance, fact, or influence that contributes to a result' (Oxford Dictionary, 2016).

Turner and Müller's (2005) study, conducted through surveys, showed the complexities that organizations face to identify a set of factors, criteria, and key performance indicators (KPIs):

- Selection criteria – different KPIs need to be checked during the life cycle, due to the changing perspectives from which the project should be seen.
- Organizational structure – performances are affected by different structures (e.g. functional, project orientated, or matrix) (Larson and Gobeli, 1989).

- Size of the project – the importance of factors can shift and change as the number of activities change.
- Industrial sector – the priorities and objectives (e.g. time, cost, quality) can vary for different industries (Pinto and Covin, 1989).
- Different stakeholder perspectives – different stakeholders (user, general public, owner, developer) could have different expectations.
- Different life cycle stages – each project may be at different stages of the life cycle, which requires different efforts, tasks, and actors.

A solution for the discussion of different opinions for measurement would be, to find a simple method that can be applied easily and that parties could agree to (Pinto and Slevin, 1988). The golden triangle (time, cost, and quality) was generally an agreed upon foundation for the definition of project success in early research (Westerveld, 2002). Some authors however, have added the criteria of client satisfaction; this makes project success a 'virtuous square of criteria': time, cost, quality, and client satisfaction (Baker, et al., 1974; Voss, 2012). Later on project success became hexagon with the addition of strategic objectives, satisfaction of the stakeholders, and satisfaction of the end users (Ika, 2009). See Figure 18 for a visual representation of the evolution of success criteria. Even if the successes criteria are known, there are still success conditions or factors that the project must meet to be successful.

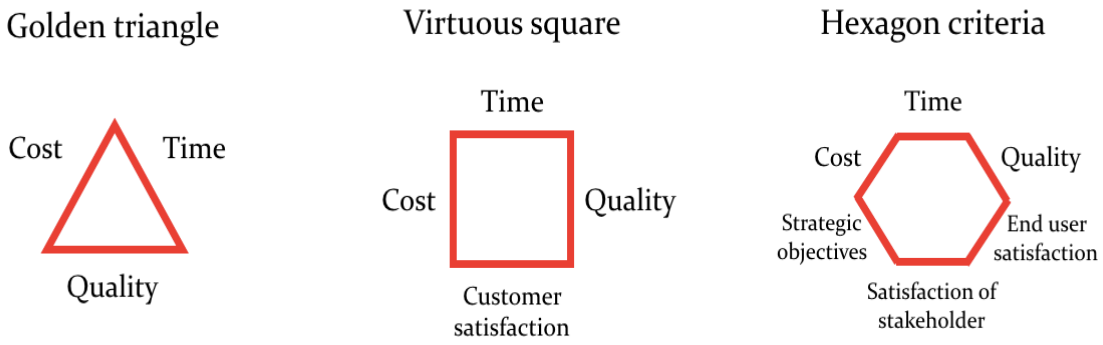


Figure 18: The evolution of project success criteria as described by Ika (2009)

Critical success/failure factors

The CFSs factors influence the implementation of the organization's strategy (Constantino et al., 2015). Many studies create lists of CSFs, but the lists differ in purpose and scope. The success factors consist of either very specific factors, affecting only a particular project, or very general factors. This makes it difficult for researchers and project managers to evaluate projects based on the variety of factors.

Not only are there differences in practice, but also in literature. Rubin and Seeling (1967) were among the first who studied success and failure factors. They investigated the impact a project manager had on the project's success or failure; in this instance, technical performance was used as a measurement of success. More studies emerged on success and failure factors. Rockart (1982) used CSFs in the context of information systems (IS) and project management and defined success factors as: 'those few key areas of activity in which favourable results are absolutely necessary for a particular manager to reach his or her own goals…those limited number of areas where "things must go right".'

Schultz, Slevin, and Pinto (1987) produced one of the firsts studies that classifies success and failure factors. They organized factors as either strategic or tactical. Strategic includes factors such as the project mission, broad and general levels of detail, and top management support, whereas tactical consisted of more detailed factors that are narrow and problem specific. In their follow-up work Pinto and Slevin (1989) identified success factors and the relative importance they hold for each stage of R&D in the project life cycle. Pinto and Prescott (1988) also did further research and found the relative importance of tactical and strategic success factors over the project life cycle. It was found that, depending on the success measure used, factors vary at different stages of the project life cycle.

Pinto and Slevin (1987) compiled a list of ten critical factors that are crucial for project implementation, through an empirical study. The factors were identified and a diagnostic tool, the project implementation profile (PIP), to be utilized by project managers, was developed as seen in the Table 24 below:

Table 24: Project success factors identified by Slevin and Pinto (1986)

#	Factor	Definition
1	Project mission	Initial clearly defined goals and general directions.
2	Top management's support	Willingness of top management to provide the necessary resources and authority/power for project success.
3	Project Schedule/Plan	A detailed specification of the individual action steps for project implementation.
4	Client Consultation	Communication, consultation, and active listening to all impacted parties.
5	Personnel	Recruitment, selection, and training of the necessary personnel for the project team.
6	Technical Tasks	Availability of the required technology and expertise to accomplish the specific technical action steps
7	Client Acceptance	The act of 'selling' the final project to its ultimate intended users.
8	Monitoring and Feedback	Timely provision of comprehensive control information at each stage in the implementation process.
9	Communication	The provision of an appropriate network and necessary data to all key actors in the project implementation.
10	Troubleshooting	Ability to handle unexpected crises and deviations from plan.

Since the development of the PIP, several studies have tried to discuss and verify specific details (or effects) of the factors (Bryde, 2008; Belout and Gauvreau, 2004; Pant and Baroudi, 2008). Cooke-Davies (2002) concluded on 12 CSFs, from 136 projects, which do not confirm nor deny the PIP; some of the factors are the same, but Pinto and Slevin's study does not consider the topic of risk management. Constantino et al. (2015) did a cross industry test of 150 projects to see if the ten success factors by Slevin and Pinto still apply today. Their results showed that after more than 20 years there is still a debate around critical success factors.

Recent studies have become more specific of the project environment and industry, for example a survey study by Chow and Cao (2008) of 109 Agile projects (25 countries) concluded on their own 12 success factors: management commitment, team environment, organizational environment, team capability, project management process, customer involvement, project definition process, delivery strategy, project nature, agile software

techniques, project schedule, and project type. Another survey by Alexandrova and Ivanova (2013) was done on projects financed by the Operational Programmes of the EU in Bulgaria. They concluded on the following CSFs: quality of subcontractor services, competence of the project, compliance with the rules and procedures established by the OP, competence of project team members, top management support. Ika (2009) did an extensive review, which showed that many authors have alternative sets of CSFs and it is still a topic open for discussion (Constantino et al., 2015).

Chan, Scott, and Chan (2004), who focus on construction projects, grouped critical success factors from different literature into five main categories. These categories include human-related factors, PM actions, project-related factors, project procedures, and external environment (see Appendix A1 for their framework). The following Table 25 summarizes project success factors of some studies:

Table 25: Project success factors and authors

Pinto and Slevin (1987)	**Chow and Cao (2008)**	**Ika, Diallo, and Thuillier (2012)**	**Alexandrova and Ivanova (2013)**	**Davis (2014)**
Quantitative – 52 survey responses Mainly locally based Fortune 1000 companies (University of Pittsburgh)	**Quantitative** – 109 projects Agile projects 25 countries across the world	**Quantitative** – 178 projects World Bank project supervisors	**Quantitative** – 132 responses Projects funded by OP of the EU	**Qualitative** – systematic integrative literature review
1. Project mission 2. Top management support 3. Project schedule/plan 4. Client consultation 5. Personnel 6. Technical tasks 7. Client acceptance 8. Monitoring and feedback 9. Communication 10. Troubleshooting	1. Management commitment, 2. Organizational environment, 3. Team environment, 4. Team capability, 5. Customer involvement, 6. Project management process, 7. Project definition process, 8. Agile software techniques, 9. Delivery strategy, 10. Project nature, 11. Project type, 12. Project schedule.	1. Monitoring 2. Coordination 3. Design 4. Training 5. Institutional Environment	1. Competence of the project, 2. Compliance with the rules and procedures established by the OP, 3. Quality of subcontractor services, 4. Competence of project team members, 5. Top management support.	1. Cooperation/ collaboration/ consultation/ communication 2. Time 3. Identifying/agreeing objectives/mission 4. Stakeholder satisfaction (quality) 5. Make use of finishing product/acceptance 6. Cost/budget 7. A project manager competencies and focus 8. The project delivering the strategic benefit 9. Top management support/executive commitment

3.10 PROJECT PORTFOLIO SUCCESS

Success Criteria vs. Success Factors

We continue to make a distinction between success criteria and success factors. Success criteria is measured by the success or failure a project or business will be judged on, whereas success factors are the inputs to the management system, that lead directly or indirectly to the success of the project or business (Cooke-Davies, 2002).

3.10.1 SUCCESS CRITERIA

Success is defined differently across all industries; the contexts of the projects vary, and so does the definition of success (Shenhar et al., 2001). Many studies have shown that, to have a sustainable view of success, financial criteria alone are insufficient (Voss and Kock, 2013). The managerial focus of firms has shifted towards the effective link of management of projects portfolio to the overall business purpose (Artto and Dietrich, 2004; Dietrich and Lehtonen, 2005). Successful PPM could deliver additional benefits to an organization beyond that of time, budget, and quality (iron triangle) (Meshendahl, 2010). Killen et al. (2008) concluded that in their correlation study, of a diverse range of services and manufacturing industries, it was found that there is a positive correlation between project portfolio performance measures and new product success.

Cooper et al. (1999, 2001, and 2002) summarized the objectives of PPM, which are frequently cited and are well established in the literature. The first three objectives are researched more, but in more recent literature, Cooper et al. (2002), added a fourth objective. The objects are as follows:

(1) **Value Maximization** – some firms focus on allocating resources and maximizing the value of the portfolio in terms of the company objectives. These objectives include long-term profitability, return-on investment, the likelihood of success, and other strategic objectives.

(2) **Balance** – the right balance must be achieved by using some parameters: the balance between long-term and short-term projects; high-risk projects versus low-risk projects; and the balancing of technologies, markets, products categories, and project types.
(3) **Strategic direction** – the final portfolio of projects must truly reflect the business's strategy and the breakdown of spending across projects, areas, markets and other categories that are directly tied to the business's strategy.
(4) **The right number of projects** – the three objectives mentioned above all have superimposed resource constraints, but this objective attempts to quantify the project's demand for resources (usually 'people' expressed as 'person-days' of work) versus the availability of the required resources.

Meskendahl (2010) states that the first of Cooper et al. (2002) objectives (maximizing value) can be divided into two separate dimensions: (1) average single-project success (time, quality, budget, and customer satisfaction), and (2) the use of synergies between projects. Some authors consider the following as the dimensions of project portfolio success: (1) average project success; (2) portfolio balance; (3) strategic fit; (4) use of synergies; (5) preparing for the future; (6) economic success (Meshendahl, 2010, Teller and Kock, 2013).

The *average project success* (discussed in more detail in section 3.10.3) corresponds with the foundation that portfolio management is built on, being a group of projects that make up a portfolio (Killen et al., 2008; Martinsuo and Lehtonen, 2007). Average single-project success is the fulfilment of the project performance criteria, which include the classical golden triangle (time, cost, quality), as well as customer satisfaction on the projects in the portfolio (Shenhar et al., 2001; Martinsuo and Lehtonen, 2007; Ika, 2009).

Project management literature states that a portfolio value could be maximized if the right dimensions are *balanced*, for example, associated risk, project size, balance between long- and short-term projects (Archer and Ghasemzadeh, 1999), project type, and resource adequacy (Killen et al., 2008; Teller et al., 2012).

The intention for *strategic fit* results from a fit between factors such as environment, technology, structure, and strategy (Voss, 2012). Portfolio strategic fit reflects the degree to which the portfolio represents the company's strategy. Shenhar et al. (2001) states that projects in the future will become the engines that drive strategy into the desired directions, and no longer be just operational tools for executing strategy.

Researchers have increased emphasis on *preparing for the future* since Shenhar et al. (2001) introduced it as a success criterion for project success. This measure is applied to the portfolio level instead of the single-project-level success in more recent literature (Jonas, 2010; Teller and Kock, 2013; Voss and Kock, 2013). Preparing for the future refers to the company's ability to seize opportunities that may arise – long-term aspects such as markets, ideas, innovations, products, skills, and technologies (Shenhar et al., 2001).

Economic success addresses the short-term economic effects at corporate level; this includes the overall commercial and market success of the organization or unit (Meskendahl, 2010).

The value gained from the interdependencies that are used through the capitalization and avoidance of redundancies of single projects in the portfolio management, is called *synergy exploitation* (Meskendahl, 2010; Jonas, 2010).

Business success is generally separated into two components: market success and commercial performance (Shenhar et al., 2001). Market success is achieving the market share and sales volume objectives. While commercial success is measured through the classical financial management criteria (POI, time to break-even, profitability, etc.) (Shenhar et al, 2001). These criteria are also applicable to the portfolio level.

Jonas (2010) classifies average project success, use of synergies, strategic fit, and portfolio balance under portfolio success, while business success and preparing for the future are classified under project portfolio-related corporate success.
To address the inconsistency of the definition of success, this study constructed Table 26 that compares the different criteria used by various authors.

Table 26: PPM success criteria, and authors

	Cooper et al. (1999)	Dye and Penny-packer (1999)	Dietrich and Lehtonen (2005)	Jonas (2010)	Meshendahl, 2010	Beringer et al. (2012)	Kock et al., (2013)	Teller and Kock (2013)	Voss (2012)	Voss and Kock (2013)	Kopmann et al., (2014)	Marnewick (2015)	Stettina and Hörz (2015)	Kock et al., (2016)
Project link to strategy	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Portfolio balance	X	X		X	X	X	X	X	X	X	X	X	X	X
Average single-project success				X	X	X	X	X	X	X	X	X		X
Use of synergies				X	X	X	X			X	X			
Future preparedness				X				X	X	X	X			X
Maximizing value	X	X										X	X	
Overall business success				X						X				X
Economic success								X						
Average product success								X						
Resources aligned with strategy			X											
Portfolio implements strategy			X											

As seen in the table above, the top six success criteria found in the literature are the following in ranking order: (1) projects linked to strategy; (2) portfolio balance; (3) average single-project success; (4) use of synergies; (5) future preparedness; and (6) maximizing value. By using Meskendahl's (2010) reasoning of the maximizing value criteria divided into the use of synergies criteria and average single-portfolio success criteria, could narrow down the success criteria to three, but how the success should be measured depends on the choice, project, and interpretation of the researcher or practitioner. In this study, the top six success criteria will be discussed, but only the top four will be included in the quantitative and qualitative tests. The top six success criteria:

1. **Project linked to strategy**
2. **Portfolio balance**
3. **Average single-project success**
4. **Use of synergies**
5. **Future Preparedness**
6. **Maximizing value**

The criterion of average single-project success is linked to the success factor category of single-project level activities and characteristics, and is thus important in this study. Although synergies criteria are slightly more used, it is easier to measure the value maximization through financial methods, because it is less dependent on the types of projects.

3.10.2 TOP 6 PORTFOLIO SUCCESS CRITERIA IDENTIFIED IN THIS STUDY

PROJECT PORTFOLIO ALIGNED WITH STRATEGY

According to Table 26 above, strategic fit is the criterion that is used most to evaluate project portfolio success. According to literature, projects are the main vehicles to implement an organization's strategies (Killen et al., 2008; Dietrich and Lehtonen, 2005; Artto et al., 2008; Morris and Jamieson, 2005). Hence, the *strategic fit* is an important success criterion that should incorporate the extent to which the projects (in the portfolio) reflect the company's strategy (Teller and Kock, 2013).

According to Cooper, top performing companies focus on non-financial methods for portfolio planning, such as strategic PPM methods. This is still a fiercely debated topic that gets criticized, especially by those who are sold on the net present value (NPV) as the main criterion (Englund and Graham, 1999).

The strategic fit of a project describes the degree of all projects being aligned with the business strategy. Reflecting regularly on the project portfolio regarding the strategy, contributes to the alignment of both the resource allocation and project goals with the corporate strategy (Dietrich and Lehtonen, 2005). Success from a strategic perspective is reliant on the organization's ability to implement required directions of action (Dietrich and Lehtonen, 2005). There is a lack of theoretical literature on the strategic fit for project portfolio management (Meskendahl, 2010).

Dietrich and Lehtonen (2005) did an empirical study on successful management of strategic intention through multiple projects. Their definitions of success was: (1) projects are aligned with the strategic intention of the organization; (2) resource allocation are aligned with the strategy; (3) the degree of the organizational strategy implementation through the portfolio projects. Their portfolio success is closely linked to the portfolio success defined by Cooper et al. (2002); however, their study is limited by subjective opinion through the Likert scale approach.

Coordinated management of a portfolio's projects carries benefits beyond the results of projects that are managed independently (Platje et al., 1994; Cooper and Edgett, 2003; Martinsuo and Lehtonen, 2007).

BALANCING

It is the second most frequently used criteria. The ultimate goal of linking organizational strategy and PPM is to establish a balanced and executable plan to achieve organizational goals (Hyväri, 2014). A balanced portfolio is the desired combination of projects that expose the organization to minimal risk, while achieving the growth and profit objectives related with the corporate strategy (Mikkola, 2001).

McFarlan (1981) noted two main reasons for project failure: (1) failure to assess individual projects, and (2) failure to consider the combined risk of the project portfolio. Many tools and methods of PPM is developed to test the balance (among other things) of the project or portfolio, for example Bubble diagrams, portfolio maps derived from scoring models, traditional charts, and portfolio matrices. Balancing a portfolio is an important part of the selection process as well as the success of the portfolio. Portfolio decisions must be balanced on a multitude of differing goals of an organization. Organizational performance measures or pressures must be taken into account when balancing the portfolio (Müller et al., 2008).

Project management literature suggests that for maximized portfolio value, numerous dimensions are needed to find the right balance (Killen et al., 2008; Cooper et al., 2002). These dimensions do depend on the environment and market of the organization. Various criteria can be used to evaluate the balance, e.g. alignment to the objectives, benefits financial/non-financial; alignment to the strategy; risk exposure; market share; regulatory compliance (Marnewick, 2015). Cooper et al., (1997) found that popular dimensions are risk vs. reward, ease vs. attractiveness, and breakdown by market, project type, and product line. Markowitz (1952) states that the assessment of risk and reward must be based on the overall portfolio and not just the characteristics of individual projects. By evaluating the portfolio, lacking gaps and the competitive position of the projects can be identified. When portfolio balance and alignment are properly combined, organizations should be able to identify which projects should be cut and which should be funded (Reyck et al., 2005).

AVERAGE SINGLE-PROJECT SUCCESS

Assuming project portfolio is a collection of projects, then naturally the success of projects within the portfolio leads to the success of the portfolio itself. As elaborated under section 3.10.3, the average project success is the fulfilment of the project performance criteria, which include the classical golden triangle (time, cost, quality), as well as customer satisfaction on the projects (Shenhar et al., 2001; Martinsuo and Lehtonen, 2007; Ika, 2009).

Cost and time are usually maintained well, by providing information throughout the project, while quality and scope are only verified at the project close out (PMI, 2013). Project management has a scheduled end and start, while portfolio management is a continuous process. Portfolio management process activities can be integrated into other organizational processes, for example annual strategic review with scheduled updates (Hyväri, 2014). Teller et al. (2012) show in their study that the formalization of both PM and PPM is connected to portfolio success.

USE OF SYNERGIES

Greater benefit can be expected through the coordinated management of all projects in a portfolio, rather than independently managed projects (Platje et al., 1994). There are several studies that share the same view (e.g. Martinsuo and Lehtonen, 2007; Cooper and Edgett, 2003; Meskendahl, 2010; Engwall and Jerbrant, 2003; Jonas, 2010; Beringer et al., 2012; Kock et al., 2013; Voss and Kock, 2013; Kopmann et al., 2014).

There are many complexities of the numerous interdependencies that hinder this practice, but it is worth the effort to minimize double work and improve synergies concerning knowledge, resources and marketing (Meskendahl, 2010; Loch and Kavadias, 2002). As Pattikawa et al. (2006) showed in their study, technology and market synergy are positively related to product success, and as explained under single-project success, the success of projects contributes to the success of the overall portfolio.

PREPARING FOR THE FUTURE

Since Shenhar et al. (2001) introduced preparing for the future as a project success criterion, researchers have started applying it to portfolio success (see Jonas, 2010; Teller and Kock, 2013; Voss and Kock, 2013). Teller and Kock (2013) described preparing for the future as follows: 'Preparing for the future deals with the long-term aspects and considers the ability to seize opportunities that arise after the projects have been brought to an end'. Maltz et al. (2014) argued that not only is preparing for the future a success factor for single-project-level, but also for corporate and higher business level.

Preparing for the future may also relate to the improvement of new markets, technologies, processes, skills and competencies, and the capabilities to face the external market or technological challenges (Shenhar et al., 2001; Meskendahl, 2010). Jonas states that the dimensions therefore include 'the indirect benefits and opportunities from projects that are realized long after project completion, such as skills learned in project execution and the development of new technologies or new markets'.

FINANCIAL VALUE MAXIMIZATION

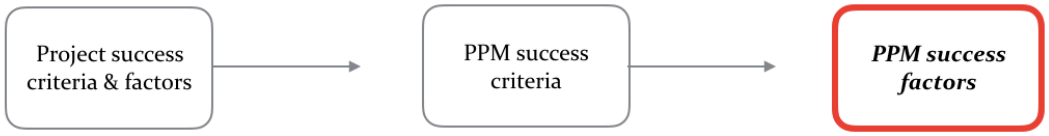
The oldest criterion that a portfolio was measured with in past literature and practice, was the financial value maximization criteria. Organizations are there to create profit for their shareholders; even non-profit organizations need to make a profit (or be financially viable) to be sustainable (Marnewick, 2015). Financial evaluation is an easy concept to grasp for a quantifiable worth of the projects or the portfolio. Portfolio management must try to maximize the financial value of the portfolio while minimizing the risk exposure; the degree of risk the organization is willing to take on, is decided by the organization.

The financial manager must examine and determine which financial factors are relevant and should be used. Return on investment, investment commitment, and the investment period should all be included in the financial factors (Hill, 2007). According to Cameron (1986), most businesses have traditionally used financial measures to evaluate and assess success. More recent studies have shown however, that financial methods are not sufficient to be the only measurement for the organization's long-term success. This has led to the advance of the multidimensional success measurement tools, such as the Balanced Scorecard, among others (Meskendahl, 2010). There are also several valuation methodologies such as the return on investment (ROI), net present value (NPV), economic value added (EVA), and internal rate of return (IRR).

Jeffery and Leliveld (2004) did an empirical study that focused on IT portfolio management; they received 130 completed surveys of which 90% were from CIOs. Their study reported that only 25% of their survey respondents track financial measures after the investment has been made. This could lead to stop the organization from expanding successfully, due to unprofitable projects still receiving investments. Reyck et al. (2005)

also performed an empirical study that determined which are the most common valuation methodologies. Their findings were (in ranking order): payback (93%), ROI (85%), NPV (68%), IRR (65%), and EVA (31%).

3.10.3 Four Main Catergories of Success Factors



Portfolio success factors are critical factors that are required to achieve the desired success of a portfolio. Although the factors could not take responsibility for the success or failure alone, addressing the factors would contribute to the success of the portfolio (Marnewick, 2015). Dietrich and Lehtonen (2005) identified four categories of portfolio success factors as follows: (1) single-project-level characteristics and activities; (2) multi-project level characteristics and activities; (3) link between projects and strategy process; (4) availability and quality of project information.

Single-project-level characteristics and activities

Some strategy-based PPM practices advise that portfolio-level decisions should be made at a single-project level or over a development process (Archer and Ghasemzadeh, 1999; Cooper et al., 1997, 2000, 2002; Stamelos and Angelis, 2001; and Platje et al., 1994). Martinsuo and Lehtonen (2006) found in their study of a variety of industries, that single-project management is linked with portfolio management efficiency. Their quantitative study shows that single-project factors such as goal-setting, decision-making, and information-availability are related to portfolio management efficiency. It can be assumed that single-project success influences portfolio success, since a portfolio is made up of projects as seen in Figure 19. Meshendahl (2010) proposes that one of the key elements in project portfolio success is single-project success. The triangle of virtue (cost, time, and quality) was generally an agreed foundation for the definition of project success in early research as explained in section 3.9 (Westerveld, 2002).

Elonen and Artto (2003) state that their study's results indicated insufficient definition, management of single-projects and planning; the problems in this area mostly suggest inadequacy in the pre-project phase and in project monitoring and control. Martinsuo and Lehtonen's (2006) findings also stressed the importance of single-project management capabilities and PPM efficiency practices. They stated that companies should pay more attention to the way in which they go about building links between single-project management capabilities and the PPM efficiency practices. Some companies plan and organize separate systems for PPM, while other companies implement the concept into single-project management.

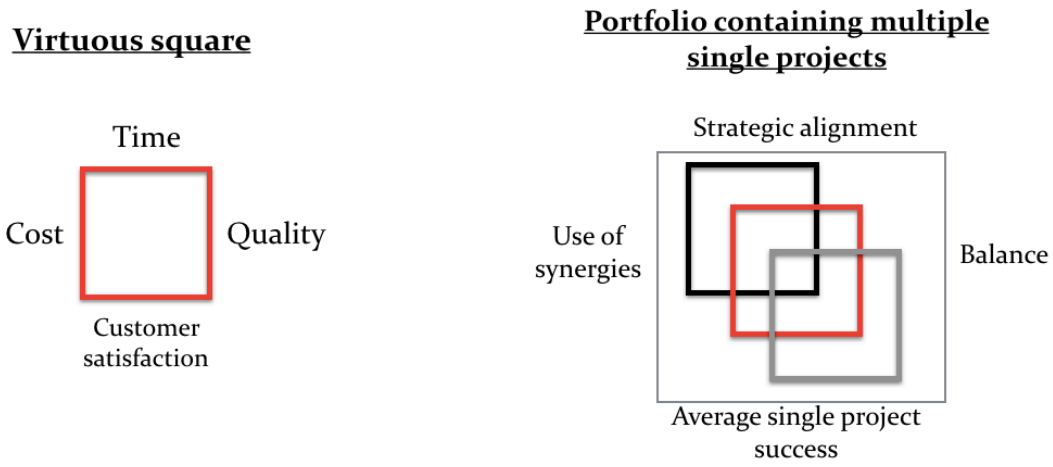


Figure 19: Portfolio containing multiple single projects and their individual constraints.

'Multi-project-level characteristics and activities

Effective and efficient single-project management is no longer enough to reach success or gain a competitive advantage, but a structured and proactive management plan could be the answer (Elonen and Artto, 2003). The literature acknowledges that it is not ideal for single projects to be isolated entities, but they should rather be treated in the complex context that is set by the programmes or project portfolios of which the project is a part (Müller et al., 2008). Some authors have called the multi-project setting 'project portfolio management' (Martinsuo and Lehtonen, 2006; Archer and Ghasemzadeh, 1999; Dye and Pennypacker, 1999; Cooper et al., 1999; and Platje et al., 1994). Platje et al. (1994) state that more benefits can be delivered from managing all the projects within a portfolio, than from managing the individual projects independently. Elonen and Artto (2003) found in

their study that the most frequently mentioned problem in portfolio level activities is the overlapping of tasks and projects. They concluded that this could be a result of the same work being done a few times in one or several different projects, the objectives of all projects that are not systematically integrated into the strategy, and/or the projects that are not prioritized due to the lack of methods for prioritization.

Although the managing of a portfolio can be complex, proper management and practices can decrease work and risk, and enhance synergies such as resources, knowledge, marketing, and technologies (Loch and Kavadias, 2002). According to Patanakul (2015) the effectiveness in managing the portfolio can be increased if the the adaptability of the portfolio to internal and external changes is increased.

To assess PPM and its effects, the results have to be measurable and stretch over a broader perspective than individual projects (Dietrich and Lehtonen, 2005; Martinsuo and Lehtonen, 2007). A variety of different measures, tools, and models are used, but a widely agreed approach to project portfolio success is to focus on objectives suggested by Cooper et al. (2002). Traditionally organizations have used financial measures and models, but this is proven to be an insufficient indicator of a firm's long-term success and has led to the increase of a variety of different measurement models (Meshendahl, 2010). Killen and Hunt's study proved that strategic methods could result in a better alignment of projects with the business strategy, and that portfolio mapping methods result in a better balancing of a portfolio. Other popular methods are the scoring methods that are used to rank projects. There is an assortment of tools and techniques for optimal selection of projects and portfolios.

Link between projects and strategy process

In strategy development literature, the strategic fit is the alignment of the business strategy, functional strategy and ultimately the project plans (De Wit and Meyer, 2003; Patanakul, 2015). According to researchers, such alignment lead to improved business performances (Byrd et al., 2006; Zatzick et al., 2012; Wheelright and Clark, 1992).

One of the major objectives and challenges in a portfolio is the link between projects and strategy (Cooper et al., 1999). The PPM literature encourages selecting and prioritizing projects based on the organization's strategy (Martinsuo and Lehtonen, 2005). To complement the goals of single projects, PPM aims to do the right projects that create a link from the projects to the strategy, simultaneously achieving long-term success (Elonen and Artto, 2003). According to Shenhar et al. (2001), a strategic management concept is, to define and assess project success which helps to align the project efforts with the short- and long-term goals of the organization. Rapid change and global competition force organizations to be quick to respond and to be more competitive. Shenhar et al. (2001) states that projects must be perceived as strategic weapons, created for a competitive advantage and economic value; project managers must assume the role of strategic leaders who take responsibility for project business results. No longer will projects be just operational tools that execute strategy; rather, they will be the driving force for new strategic directions.

A common characteristic or objective in a variety of approaches is to increase the manageability and coordination over multi-projects, resulting in better links between projects and strategic aims (Dietrich and Lehtonen, 2005). Martinsuo and Lehtonen (2005) found a positive indirect relationship between clearly-specified goals (scope, costs, and time) and portfolio management efficiency, through PM efficiency and reaching individual project goals. The literature suggests that the portfolio selection approach must be fitted to the surrounding organization's characteristics and strategy (Englund and Graham, 1996; Stawicki and Müller, 2007). To prove this, Müller et al. (2008) found a positive correlation between the selection of projects for the portfolio, based on the organization's strategy. Also, portfolio management-driven organizations are more advanced in decision-making practices than less mature multi-project organizations. Killen et al. (2008) showed that the use of a strategic method could result in the better alignment of projects with the business strategy. Organizations that successfully manage strategic alignment in multi-project environments, review and analyse the objectives of ongoing projects as well as the links to strategic formulation (Dietrich and Lehtonen, 2005).

The portfolio must continuously be monitored to check if the projects, portfolio, and resource use is in alignment with the intended corporate strategy. If the projects, portfolio and resources are constantly checked, corrective actions (e.g. resource re-allocation, re-scheduling) could be taken if overruns take place (Pajares and López, 2014). This process is dynamic and continuously changing to adapt to the changes within the portfolio. As new projects enter and other projects exit the portfolio, project ranking changes. As a result, priority changes and projects may conflict, since they are all competing for the same scarce resources.

Availability and quality of project information

Martinsuo and Lehtonen (2007), who focused on single-project factors, found that the availability of information on projects was shown to be the most significant factor (for decision-makers) that contributed to PPM efficiency, directly and through PM efficiency. Müller et al. (2008), who focused on multi-projects, also found a positive correlation between projects, programme reporting, and portfolio performance. Information has an impact not only on the portfolio manager, but on everyone in the portfolio management process. The project portfolio provides an organization with a snapshot of its current strategic direction, making it important for portfolio managers, portfolio teams, organizational executives, and other stakeholders to have accurate information about the portfolio's status (Khan, 2015).

Relevant information is necessary to make informed decisions; by addressing the information problem, other portfolio management questions can be addressed (Joslin, 2015). Archer and Ghasemzadeh (1999) state that internal competencies and external environmental data should be considered carefully before strategic decisions about the project portfolio are made; data should be relevant and accessible. The firm's ability to generate information systematically for competitive advantage is known as the 'analytical posture' (Morgan and Strong, 2003). This posture considers systematic environmental analysis, for example of market developments, new technologies, technology development, and strategic competence (Meskendahl, 2010).

Frequently, however, there is a lack of transparency and information flow. Personnel can suffer from information overload, or they are not always told what information to use, to whom it must go, how, and in what format (Elonen and Artto, 2003). When using business cases, the quality of the project portfolio selection is constrained by the quality of the information. Kopmann et al. (2014) argues that a sound business case may be a cause of project and project portfolio success. This correlates to Patanakul's (2015) statement that higher effectiveness in managing the project portfolio can be achieved by higher visibility.

CHAPTER 4 - FRAMEWORK

In the previous chapters, the process to develop a framework was explained (Chapter 2), as well as a thorough literature review with focus on project portfolio management (Chapter 3). Little research has been done from an South African perspective on assesses the project portfolio management success factors. Therefore, it is necessary to develop such a framework that can evaluate the factors that influence project portfolio management success. The framework in this chapter is a summary of the literature gathered for this study in Chapter 3 through the methodological process explained in Chapter 2. Figure 20 is the process that was followed to answer the questions in Table 27 that are addressed in this chapter.

Figure 20: Main sections in this chapter

Table 27: The main questions addressed in Chapter 4

This section aims to answer the following main questions		Sections questions will be addressed
1	Which key works were used to construct the framework?	4.1 Key works
2	How was the framework validated?	4.3 Framework validation
3	Were there any adjustments made to the framework?	4.3 Framework validation

4.1 SUMMARY OF MAIN AUTHORS

Through a thorough literature review found in Chapter 3, it was decided to use Dietrich and Lehtonen's (2005) four identified categories of portfolio success factors, for this thesis's conceptual framework. The four categories are: (1) single project-level characteristics and activities; (2) multi-project-level characteristics and activities; (3) link between projects and strategy process; and (4) availability and quality of project information.

Table 28 is a summary of the main literature that has contributed to the planning and development of the success factors for the conceptual framework in this thesis. The table summarizes the methodology and context that each contributing author used and linked it to the practice number in the framework's factors (best practice) that were identified in this thesis.

Table 28: Links between factors of best PPM practices and various works

Author	Title	Methodology and context	Contribution to the design of the conceptual framework			
			Single-project level	Multi-project level	Project link to strategy	Information management
Archer and Ghasemzadeh (1999)	An integrated framework for project portfolio selection	**Conceptual paper** – describes steps of evaluating and selecting a portfolio	1; 2.1; 2.2	5; 6; 7.1; 7.2; 7.3; 7.4; 7.5; 7.6; 7.7; 8	9.1; 9.2; 10.1; 10.2; 11.1; 11.2	12.1; 13.1; 13.2
Cooper et al. (1997)	Portfolio management in new product development: Lessons from the leaders I & II	Part I**: Qualitative** – 35 portfolios North America New product development (leading firms) Part II: **Quantitative** – 205 portfolios North America New product development (not just leading firms) Part III: **Qualitative** – 30 interviews North America New product development (leading firms)	2.1; 2.2	4; 5; 6; 7.1; 7.2; 7.3; 7.4; 7.5; 7.6; 7.7; 8	9.1; 9.2; 10.1; 10.2; 11.1; 11.2	12.1; 12.2; 13.1
Cooper et al. (1999)	New Product Portfolio Management: Practices and performance					
Cooper et al. (2001)	Portfolio Management for New Product Development: Results of an Industry Practice Study					
Dietrich and Lehtonen (2005)	Successful management of strategic intention through multiple projects Reflections from empirical study	**Quantitative** – 288 survey responses Finland / Europe	1; 2.1; 2.2	4; 5; 6; 7.1; 7.5; 8	9.1; 9.2	13.1; 13.2
Elonen and Artto	Problems in managing internal development projects in multi-project environments	**Quantitative** – 2 portfolios (20 interviews + 18 survey responses) Finland Matrix organization	2.1; 2.2; 3.5	4; 5; 6; 7.1; 7.2; 7.3; 7.4; 7.7; 8	9.2; 10.2; 11.2 12.1;	12.1; 13.1; 13.2; 13.3; 14; 15

Killen et al. (2008)	Project portfolio management for product innovation	**Quantitative** – 60 survey responses Australia Diverse range of service and manufacturing industries	3.5	6; 7.1; 7.2; 7.3; 7.4; 7.5	9.1; 10.1; 11.1	
Martinsuo and Lehtonen (2007)	Role of single-project management in achieving portfolio management efficiency	**Quantitative** – 279 survey responses Finland	1; 3.1; 3.2; 3.3; 3.4	5; 7.3;	9.1; 9.2; 11.1; 11.2	12.1; 12.2; 13.1; 13.2; 13.3
Müller et al. (2008)	Project portfolio control and portfolio management performance in different contexts	**Quantitative** – 136 survey responses High-performing responses Worldwide	3.1; 3.2; 3.3; 3.4; 3.5	4; 7.2; 7.3	9.1; 10.1; 10.2	12.1; 12.2; 13.1; 13.2; 15
Shenhar et al. (2001)	Project success: A multidimensional strategic concept	**Quantitative** – 127 projects (76 companies) Electronics, Aerospace, Construction, Mechanical, Chemical	3.1; 3.2; 3.3; 3.4	7.6	9.1	
Teller and Kock (2013)	An empirical investigation on how portfolio risk management influences project portfolio success	**Quantitative** – 176 firms Europe	4	7.2	9.1; 10.1	
Voss and Kock (2013)	Impact of relationship value on project portfolio success. Investigating the moderating effects of portfolio characteristics and external turbulence	**Quantitative** – 174 survey responses Germany, Switzerland, Austria Cross-industry, medium- and large-sized companies	1; 3.1; 3.2; 3.3; 3.4 4	7.1; 7.2; 7.3; 7.4; 7.5	9.1; 10.1; 11.1	

4.2 CONCEPTUAL FRAMEWORK PROPOSED

Table 29 below is the conceptual framework that was constructed through an extensive literature review in Chapter 3. Professional practitioners can use this framework to identify frequently used practices in PPM. These practices are the building blocks for any practitioner that wishes to start practicing PPM in their organisation. More experienced practitioners can use the framework to identify other possible factors and possibly expand their own assessment factors.

Refer specifically to section 3.10.3 that explains each category in more detail. Table 28 above is a summary of some authors' studies that have helped to construct this framework.

Table 29: Four categories and factors of best practice

SINGLE-PROJECT LEVEL	
1	Use of project process models
2	Decision-making practices
2.1	Formal pre-project planning and decision-making tools selected for each individual project
2.2	Continuous formal decision-making throughout project execution
3	Clearly defined goals and success measures per single-project
3.1	Goals for costs
3.2	Goals for time
3.3	Goals for quality
3.4	Goals for client satisfaction
3.5	Goals for resources
MULTI-PROJECT LEVEL	
4	Coordinated and structured links between projects
5	Formal decision-making on multi-project management
6	Formal decision-making on resource distribution across entire portfolio
7	Methods and PPM practices to compare projects
7.1	Use of financial methods (e.g. ECV, ROI, EV, NPV)
7.2	Balancing methods (e.g. risk-reward bubble diagram, traditional charts such as pie charts, mapping method)
7.3	Use of strategic methods (e.g. strategic bucket model, strategic check, product road map)
7.4	Right number of project methods (e.g. resource demand)
7.5	Use of scoring methods
7.6	Evaluation methods adapted to the requirements of the portfolio

7.7	Stage-gate or similar type of frameworks used
8	Constant review of projects as a whole
LINK BETWEEN PROJECTS & STRATEGY	
9	Alignment of projects
9.1	Aligning each project to the strategy formulation
9.2	Reviewing and monitoring alignment of each project to the strategy
10	Alignment of portfolio
10.1	Aligning entire portfolio to the strategy formulation
10.2	Reviewing and monitoring alignment of entire portfolio to the strategy
11	Alignment of resources
11.1	Aligning resource allocations with strategy
11.2	Reviewing and monitoring the alignment of resources to strategy
PROJECT INFORMATION	
12	Decision-makers have all required information on projects
12.1	Internal information
12.2	External information
13	Information quality
13.1	Decision-makers have accurate information
13.2	Decision-makers have up-to-date information
13.3	Clarity of information is given (who, what, how)
14	Decision-makers are not overloaded with information
15	Information flows frequently between different units

4.3 FRAMEWORK VALIDATION

This framework was built on a thorough literature review. An article with the title 'Exploring the link between PPM implementation and company success in achieving strategic goals: an empirical framework', was submitted to the South African Institute of Industrial Engineering (SAIIE) for their 27th annual conference. The article was accepted to be published in the South African Journal of Industrial Engineering (SAJIE) and it was to be presented at the SAIIE conference.

This served as a validation step that completes the requirements for Jabareen's (2009) phase 7, to create a conceptual framework (refer to Chapter 2). Jabareen's (2009) phase 7 requires researchers, other scholars, and practitioners to understand the framework and

to give feedback. The article and framework was examined and accepted by three reviewers, this serves as the validation for the framework in this thesis.

The reviewers did not request any changes to the framework – only to some language errors in the article. This completed phase 8 that required changes that depended on the feedback from the reviewers.

CHAPTER 5 – DATA COLLECTION METHODOLOGY

The previous chapter presented the conceptual framework. This chapter presents the methodology that was followed to evaluate the relationships between the various conceptual framework elements. This was done by collecting data using both quantitative and qualitative approaches. The chapter is divided into two stages. The first stage considers the methodology followed for the quantitative evaluation of the framework element relationships by using a survey. The second stage considers the methodology followed for the qualitative evaluation of the framework element relationships by using interviews. Figure 21 shows these two stages and Table 30 shows the questions that will be answered in this chapter.

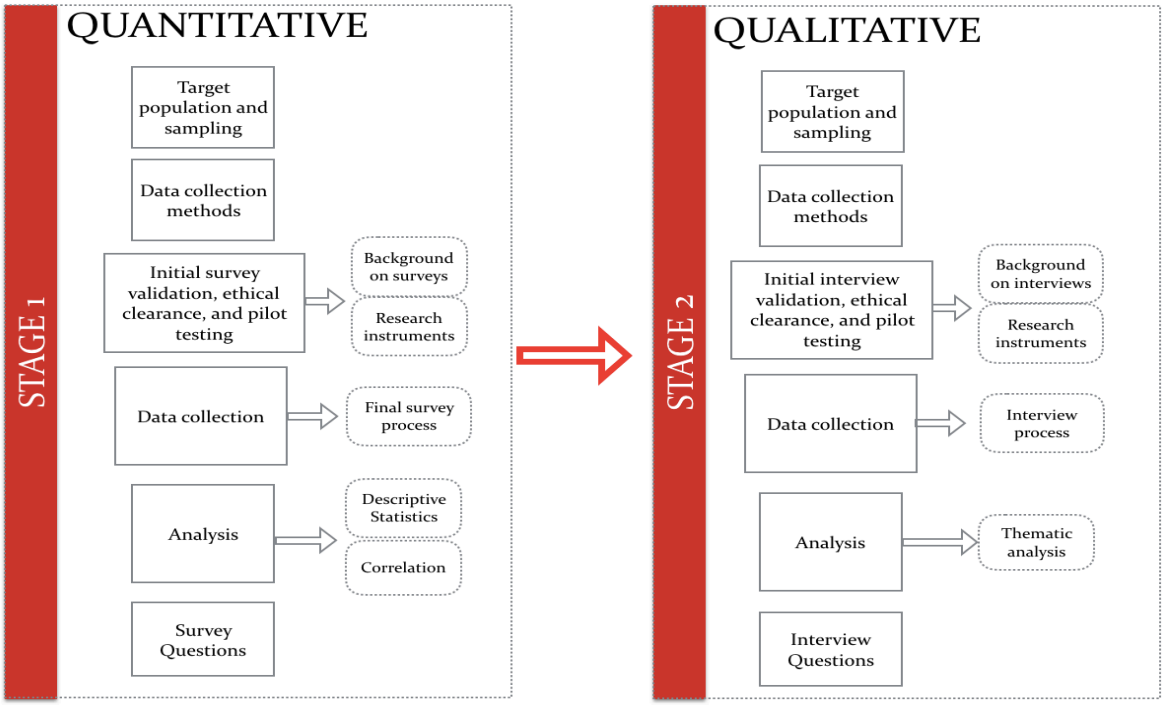


Figure 21: Methodology for empirically evaluating the conceptual framework is divided into the quantitative and qualitative stages.

Table 30: The main questions addressed in this Chapter

This section aims to answer the following main questions		Sections questions will be addressed
1	What is validity and how was it approached in this study?	5.1 Validity
2	What is a mixed method approach?	5.2 Research methodologies
3	What was the target population for the surveys and interviews?	5.3.1 & 5.4.1 Target population and sampling
4	What data collection methods were researched and used?	5.3.2 & 5.4.2 Data collection methods
5	What were the initial steps to validate the survey and interview?	5.3.3 & 5.4.3 Initial validation, ethical clearance, and pilot testing
6	How was the data collection performed?	5.3.4 & 5.4.4 Data collection
7	What methods were used to analyse the data collected?	5.3.5 & 5.4.5 Analysis

5.1 THEORY OF VALIDITY

There are three vital criteria for evaluating business and management research: reliability, replication, and validity. Reliability is the extent to which the results are consistent; the ability of reproducing the results under a similar methodology. The procedure of the researcher must be explained in a manner that will make it easy for the reader to replicate the study. As expressed by Hubley and Zumbo (1996), 'of all the concepts in testing and measuring, it may be argued, validity is the most basic and far-reaching; for without validity, a test, measure, or observation and any inferences made from it are meaningless'. Bryman and Bell (2015) agree with this statement and consider validity the most important criterion of research. Bryman and Bell (2015) also distinguish between the following important aspects of validity which were considered before any data collection took place for this thesis:

- *Measurement validity* – also referred to as the construct of validity and primarily applies to quantitative research. It questions the measurement criteria that are constructed to represent the concept that is being investigated. Hence, the measurement validity is related to the reliability.
- *Internal validity* – questions if the right conclusions are drawn from the data represented (Johnson, 1997). In other words, internal validity questions how confident can the researcher be that the independent variable is responsible for the variations identified in the dependent variable.
- *External validity* – when the researcher wants to generalize from a set of findings to other times, settings, and people (Johnson, 1997). In this case the selection and participation of organizations or people becomes crucial.
- *Ecological validity* – is concerned with the true representation of research on the natural social setting. It questions whether or not the technical findings are realistic and for instance possible, to implement it in peoples' everyday lives.

The above-mentioned are aspects of validity, but according to Ostelo and de Vet (2005) there are three main types of validity: content-, criterion-, and construct-validity.

(1) Content validity is often difficult to apply in the social sciences field (Carmine and Zeller, 1979); it evaluates the degree to which an operationalization represents the

concept that the generalization is applied to. Content validity was done through a thorough literature review and the use of theoretical definitions and validated measurement instruments.

(2) Criterion validity evaluates the degree to which the concept can accurately predict and capture the relevant aspects of the criterion (Carmines and Zeller, 1979). To improve the criterion validity, the surveys required a large number of responses; this was achieved by obtaining 342 responses.

(3) Construct validity tests if the measure is assessing the intended primary theoretical concept (Thiértart et al., 2001; Carmines and Zeller, 1979). Pilot testing the survey, and interviews assisted the research with improving construct validity. The steps that were followed to ensure this validity is tested are under section 5.3 (for quantitative) and section 5.4 (for qualitative). The measuring instrument was also pre-tested to test the reliability and stability of the surveys and interview. There was special attention given to the questions – wording and question content.

5.2 DATA COLLECTION APPROACHES AND METHODS

A number of authors (Saunders et al., 1997; Welman et al., 2002; Tull and Hawkins, 1993) proposed the following sections be present under the methodology section: type of study, the target population and sample, data collection method, research instruments used, and the data analysis approach.

Some data collection methods can vary: testing, observing, and analysing of secondary texts and surveys (Mouton, 2001). Three common ways could be used to collect data for surveys: a face-to-face interview, telephone interview, and/or through mailing a questionnaire (Malhotra, 2004). Each of these methods has their advantages and disadvantages that needs to be considered to fulfil the objectives of this study in the best-suited way. Babbie and Mouton (2003) constructed

Table 31 below that indicates the strengths and drawbacks of the three primary survey data collection methods.

Table 31: Strengths and drawbacks of the three primary survey data collection methods (Babbie and Mouton, 2003)

Type	Strength	Drawbacks
Self-administered mail questionnaires	Economical (large amounts of data can be collected) Ease of administration Relatively short time to collect data	Need a literature population Recognizable addresses Respondents may be reluctant to divulge sensitive or confidential information Incomplete questionnaires Low response rate Wrong addresses
Face-to-face interviews	Higher number of completed questionnaires Effective regarding sensitive or complicated questions Appropriate respondent can easily be identified	High cost per questionnaire Need trained interviewers Need large number of staff to administer Long time to complete questionnaire
Telephone interviews	In comparison to face-to-face interviews: lower cost; quicker Safer in high crime areas May be conducted from one central location Electronic administration can result in immediate data capturing	Biased towards those respondents who have phone numbers

Data collection for the framework testing was done in two stages, with two different means of collecting data. The first stage was conducted using an internet survey, and stage two was an interviewing process. The first stage was pre-tested in a pilot study, modifying and correcting the survey. The measurement instruments will be discussed in section 5.3.2 and 5.4.2 below.

5.2.1 RESEARCH METHODOLOGY

Mixed method research, or otherwise referred to as the 'third methodological movement' has been a debated topic for more than three decades (Denzin and Lincoln, 2011). Research methodologies are generally classified into two categories: either qualitative, or quantitative research. Qualitative research is primarily exploratory research. It provides insight, underlying reasons, opinions, motivations, and it helps to uncover problems. Quantitative research is used when generating numerical data that can be transformed

into statistics. Qualitative data collection methods are less structured than quantitative data collection methods. Mixed methods studies combine quantitative and qualitative approaches into the research methodology of a multi or single-phased study (Cotton et al., 1999; Johnson and Onwuegbuzie, 2004). Table 32 below provides a summary of the different quantitative and qualitative elements.

Table 32: Qualitative vs. quantitative research, (Leedy and Ormrod, 2001)

	Quantitative	Qualitative
Purpose of the research	• To explain & predict • To confirm & validate • To test theory	• To describe & explain • To explore & interpret • To build theory
Nature of the research	• Known variables • Established guidelines • Static design • Context-free • Detached view	• Unknown variables • Flexible guidelines • Emergent design • Context-bound • Personal view
Method of data collection	• Large representative sample • Standardized instruments	• Small informative sample • Observations & interviews
Analysis-type	• Deductive analysis	• Inductive analysis
Method of communicating findings	• Numbers • Statistics, aggregated data • Formal voice, scientific style	• Words • Narratives, individual quotes • Personal voice, literary style

5.2.2 MIXED METHOD

The mixed method has gained popularity and largely due to the ability the mixed method has, it combines the best facets of qualitative and quantitative research (Bergman, 2008; Johnson and Onwuegbuzie, 2004). Greene (2008) identifies five primary motivations to use the mixed method approach:

- **Triangulation** - the increased validity or credibility that is gained by using mixed methods is referred to as triangulation.
- **Development** - refers to the improvement of one research method using elements of another, such as instruments or samples.
- **Complementarity** - with this as a purpose, the researcher can usually tap into different dimensions or facets of the study.

- **Initiation** - denotes the new insights in findings that are generated using different methods.
- **Expansion** - methods can also be mixed to expand the range and scope of study; different methods can be used to assess different phenomena.

5.2.3 MIXED METHODS USED IN THIS STUDY

Different studies have different reasons to make use of the mixed method approach as mentioned by Greene (2008). Some studies only have one or two motivations for using mixed methods. This research, however, will use mixed methods for the all the above-mentioned reasons (triangulation, development, complementarity, initiation, and expansion) as explained in Table 33 below.

Table 33: Explanation of this study's reasons for doing a mixed method.

Purpose	This study's rationale
Triangulation	Through studying the factors that influence the success of the portfolio by means of quantitative (survey) and qualitative (interviews) analysis, the highest level of validity can be gained from both approaches.
Development	The answers obtained in the first phase (survey) developed the questions that were asked in the second phase (interviews).
Complementarity	The qualitative and quantitative methodologies are highly complementary and different facets were tapped into.
Initiation	Phase one (surveys) initiated questions and topics that were answered by the second phase (interviews).
Expansion	Phase one (surveys) was focused on the success factors influencing the success criteria, whereas phase two (interviews) allowed the researcher to expand the scope of the study and to question the different aspects linked to the factors and/or success.

5.3 QUANTITATIVE RESEARCH DESIGN (SURVEY)

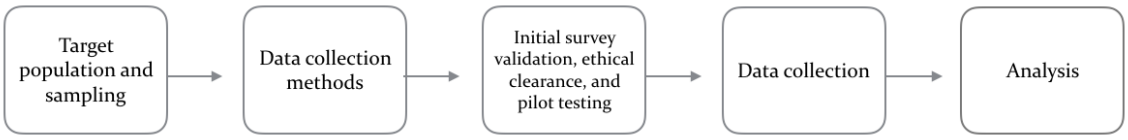
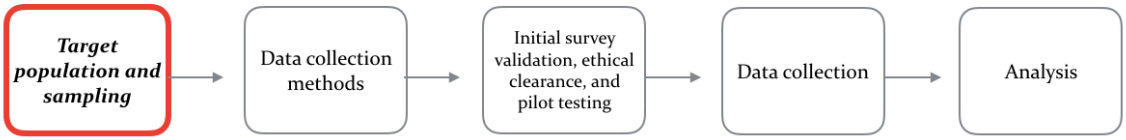


Figure 22: Stages of designing and executing the quantitative research

Figure 22 shows the steps followed in the quantitative stage of data collection. Data collection was performed through a survey that was sent to practitioners involved in the field of portfolio, strategic, programme, and project management. The first stage was created to explore the reality of factors influencing the project portfolio management success. It aims to address the research Objective 6 ('Perform an empirical study evaluating the implementation of PPM practices, the link between the implementation of PPM practices and perceived PPM success and the perceived link between PPM practices and PPM success.') stated in Chapter 1, and it answers questions in the beginning of Chapter 4.

5.3.1 TARGET POPULATION AND SAMPLING



Target population

A population is defined by the Oxford dictionary as a 'finite or infinite collection of items under considerations'. The target population in this study is South African companies that use the practices of project portfolio management as an operating tool. The survey was sent to different companies from different industries, but targeted management involved in or knowledgeable of the project portfolio management practices within the organization. The managers typically involved in or influenced by the project portfolio management practices, are the strategic managers, portfolio managers, project managers, program managers, and operational managers as explained in section 3.5 of this thesis.

Sampling

Blumberg et al. (2011) describe sampling as the process of selecting some elements of a population to represent the whole population. Sample selection can be done by different procedures. There are different approaches, but two generic approaches: the traditional approach, and the iterative approach (similar to the grounded theory). Thiértart et al. (2001) explain the order of the traditional method as follows: (1) define the population, (2) choose a sampling method, (3) determine sample size, (4) establish or find a sampling frame, (5) select sample elements, (6) collect data, (7) establish the usable sample, and (8) identify biases and correct them. They also developed steps for the iterative process as follows: (1) define the unit of analysis, (2) choose an observation unit, (3) collect and analyse data, (4) choose a new observation unit, (5) collect and analyse data, (repeat step 4), (6) sample, and (7) define the scope of the generalization for the results. The approach used in this study was the traditional approach.

The following were the first five steps taken before data collection (step 6, section 5.3.2), following the traditional approach:

(1) It was a logical choice to select the employees that are most likely to use project portfolio management practices, such as the strategic management, project portfolio management, program management, and project management (refer to section 3.5).

(2) The next step was to choose the sampling method that would best fit the study, The four sampling methods mentioned by Thiértart et al. (2001): probability sampling, judgment sampling, quota sampling, and convenience sampling. For this study the judgment sampling was selected; it is often used in management research for qualitative and quantitative processing.

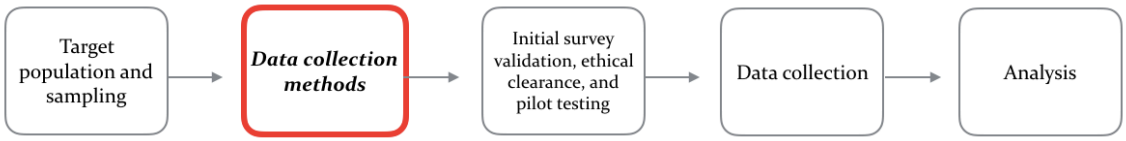
(3) Next the sample size was determined. The sample size is determined by the minimum size needed for the study to gain an acceptable degree of confidence. Quantitative data needs a size that enables an adequate degree of precision or significance level, Qualitative data needs to achieve a sample size that produces a desired level of credibility (Thiértart et al., 2001). Generally, the larger the sample size, the greater the confidence in the study, but sample sizes that get beyond a certain size can pose its own set of problems. The sample

method chosen influences the sample size needed for the study. The desired sample size needs to be determined before the data is collected. Sample size calculators were used on three separate websites designed to calculate survey sizes: Survey Monkey, Calculator.net, and Survey Systems. All three calculators determined that a minimum sample size of 321 participants was needed – given a confidence level of 95%, confidence interval of 5%, and the population size of 1942 potential participants. The sample size was achieved with 342 responses and all the responses were categorized as usable responses.

(4) The focus of this study is on strategic, portfolio, programme, and project managers.

(5) The elements were broad and applied to all strategic, portfolio, programme, and project managers.

5.3.2 Data Collection Methods



Quantitative research design was selected for this thesis. Mouton (2008) mentions that there are three main techniques for collecting quantitative data, namely, field experiments, laboratory experiments, and surveys. The survey technique was the best suited technique for this study, given the study is of a non-experimental nature and given the time and cost restriction on the study.

Background on surveys

Most academic and government surveys were done in person up to the 1970s. When telephone ownership became nearly universal (in the United States), data collection was shifting towards telephonic interviews (Fowler, 2014). An estimated fifty million people were using the Internet within the first four years of its introduction (Cook, Heath, and Thompson, 2000), and according to Internet World Stats (2015), there are more than 3.3 billion people who were using the Internet by November 2015. This increase has resulted in the most dramatic changes in survey research in recent years (Umbach, 2004). It seems that data collection has shifted to being collected by Web surveys (Dillman and Bowker,

2001). Web based surveys hold many advantages for the researchers, but it is also important to take note of the disadvantages as seen in Table 34; the quality of Web surveys might vary to other dated means of collecting data.

Table 34: Potential advantages and disadvantages of surveys

Potential Advantages	Potential Disadvantages
Global reach. With the increase in Internet users, the ability to survey more people, increases. Although Internet penetration is the lowest in less-developed countries and greatest in industrialized ones, there is still an increase in technological advances in less-developed countries that will make it possible to reach more people in the future.	***Nonresponse bias error.*** These errors occur when people are unwilling or unable to give a response and the response rates are low. Some researchers have found that pen-to-paper surveys have a better response rate than the online surveys (Sax et al., 2003; Crawfford et al., 2001).
Cost. One of the greatest advantages of Web surveys is that is a low-cost option for data collection (Carini et al., 2003; Dillman, 2000; Schmidt, 1997; Shannon et al., 2001; Watt, 1999).	***Sampling error.*** No matter how large the sample size, it cannot be said that the sample is a true representation of all the target population. Some members of the population might not have access to participate in the online survey (Dillman and Bowker, 2001).
Time. Online surveys can be a time efficient manner to collecting data (Gunn, 2002). Kannan et al. (1998) stated that the speed and reach created by using the Internet, allows for real-time access to geographically diverse respondents groups and information servers. When responses are recorded, the information is immediately available for analysis.	**Measurement error.** This error can be from inaccurate responses. Some researchers suggest that participants could have different attitudes to online surveys than to pencil and paper surveys (Sax et al., 2003). A survey can also look different on different screens or operation systems (Dillman, 2000).
Error. According to Zhang (1999), web-based surveys may also reduce errors that result from coding; there is less likely the chance of human error.	***Ethical considerations***. By sending mass emails, some people might feel their privacy has been invaded. This could happen as a result of misusing technology (Shannon et al., 2001).
Flexibility. Some researchers have suggested that online surveys have the advantage of being flexible (Evans and Mathur, 2005; Dillman, 2000; Zhang, 1999). Questionnaires can be offered to different people or groups and web surveys can also be more refined in appearance (drop-down boxes, pop-up instructions, check boxes, etc.) than paper surveys (Umbach, 2004). These design advantages could increase the respondent's motivation to complete the survey (Schmidt, 1997; Zhang, 1999; Umbach, 2004).	***Coverage error***. This is a result of a mismatch between the target population and the frame population; representativeness can be threatened when the frame population does not cover the target population. An example of this would be if a researcher targets undergraduates in their institution, but the frame population may only reach the undergraduates who have accurate email addresses.
Social. Students are more likely to answer socially threatening questions when responding to an online survey (Pealer et al., 2001). It reaches groups that are normally difficult to identify, such as gay, bisexual, lesbian, and transgender people (Coomber, 1997; Zhang, 1999).	***Technical.*** This is dependent on the researcher's expertise required to develop a functional online survey. Web development tools are becoming more user-friendy, but the researcher still needs to be familiar with the Internet protocols (Umbach, 2004; Evans and Mathur, 2005).
Data analysis. Online surveying can effectively collect data of a large number of responses. When the questionnaires are submitted, the researcher has instantaneously data stored in a base (Wilson and Laskey, 2003).	***Impersonal.*** The online survey usually has no human contact and can limit the ability of a skilled interviewer to do in depth investigation.
Follow-up. The low costs of online surveys make it easy	

for companies or researchers to send out emails of follow up reminders to increase the survey response.	
Control order. Online surveys can control the order of questions that is intended by the study designer, for example it can prohibit the respondent from looking at future questions, thus reducing survey bias (Evans and Mathur, 2005).	

Developing the research instrument

To collect appropriate, valuable, and usable data, it is critical to use reliable and valid measuring instruments. As explained in the validity section 5.1, validity questions whether the objectives that we intended to measure, were actually measured. To provide a quantifiable response, this study made use of the Likert scale that rate the majority of questions in the survey. The two most asked questions using the Likert scale were: (1) how the participants rated the frequency of using a particular PPM practice, and 2) how they perceived the particular PPM practice to benefit the success of the portfolio management (refer to question 7, 8, 9, and 10 on the survey in Appendix B1).

The survey was built with Survey Monkey and Google Docs to test and decide on the best-suited software for this particular study. Survey Monkey had limitations such as not having a double matrix rating scale, which could have made it more convenient for participants to answer the long questions. Google Docs however, did not have a matrix of dropdown menus like Survey Monkey, which made the survey seem too long. Google Docs also had a few glitches and thus this study chose to use Survey Monkey.

Survey Monkey has built in software to facilitate the design of the survey as well as the collection of responses. Using the builder option, various types of questions were asked: multiple choice, matrix of dropdown menus (using a Likert scale raking 1-5), ranking, single text box, and matrix/rating scale. It was a requirement for all questions to be answered to complete the survey. Efforts were made to minimize potential errors and inconvenience for participants where the participants only had to 'click' the correct alternative.

Likert scale background

Rensis Likert (1932) developed a scale that measure particular attitudes throughout a survey. The Likert scale, named after the inventor, has been further used and developed to measure specific attributes or traits of individuals or groups (Murray, 2013). Respondents give their level of agreement or disagreement: strongly disapprove, disapprove, undecided, approve, and strongly approve. Some researchers use a larger scale and others delete the neutral option (undecided) (Clason and Dormody, 1994).

Likert-type measures should be used appropriately and according to Carifio and Perla (2008) it has been a debate for over 50 years. There is confusion among educators, students, practitioners, and researchers. The debate begins with the type of analysis, parametric or non-parametric. Jamieson (2004), and Gardner and Martin (2007) believe that the Likert data is of ordinal or rank order nature and only non-parametric tests will yield valid results. Norman (2010) opposes their view through his findings that parametric tests such as the Pearson correlation and regression analysis can be used without coming to the 'wrong conclusion' as Jamieson (2004) described it. Murray's (2013) study to determine whether types of analyses conducted on the Likert scale data, affected the conclusion from the results which showed that parametric and non-parametric tests (such as Pearson and Spearman) do not affect the conclusions drawn from the Likert scale results.

According to Carifio and Perla (2007), the lack of understanding of the difference between Likert scales and response formats could be the root of confusion. They add that researchers should analyse item by item the responses to the Likert questions, rather than analysing it as a collection of items measuring a particular attribute. Carifio and Perla also state that it is acceptable to use the summed scales to conduct parametric tests; Pell (2005) agrees with this, provided that the assumptions are clearly stated and that the data is of appropriate size.

This study's Likert scale problem and solution

There is also a debate around the number of points (options) the scale provides. After some research and contemplation, the researcher decided to take out the mid-point of the

scale as advised in the initial survey validation. The purpose of a rating scale is to determine how strongly the interviewee feels about a topic and towards which side he is leaning. The more points there are, the more the sensitivity of the scale is increased (Cummins and Gullone, 2000). Although Likert's original scale had a neutral point, it could be ideal for market researchers not to have an intermediate position on a scale. Garland (1991) states that with that reasoning, a mid-point is preferably not included; provided the reliability and validity is not affected.

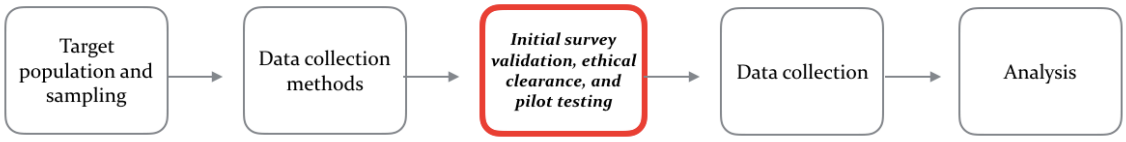
Regarding this thesis, it was difficult to choose between a four- or five-point scale, which forced the researcher to use an objective ranking method for the following two objectives (order of importance): (1) determine which factors influence the organization's PPM, (2) determine to what extent these factors influence the organization's PPM. It was a trade-off between the sides of the scale of the participants' opinions, versus an increase in sensitivity to the results. This thesis is trying to primarily determine the factors that influence the success of PPM and secondarily to find to what extent these factors influence the success of PPM. In this case it is better suited not to have a neutral/midpoint. Some specifically selected questions do have an 'I don't know' option, to not influence the accuracy of the data.

Survey length considerations

The length of the survey is an important part of this study. This study had to find a strategic balance between the accuracy and reliability of measure, and keeping the survey short enough for respondents to be willing to participate. The first version of the survey was very lengthy and consisted of 142 questions. It was decided to reduce the survey and make it more bearable for participants; this however, did affect the extent of accuracy that would've been obtained from the longer survey.

The longer survey (found in Appendix B1) did not only ask to what extent the participant perceived the practices and factors to have an influence on the overall portfolio management success, but it also asked about specific successes (strategic fit, balance, average single-project success, use of synergies). The survey was then cut down to 82 questions, focusing on the overall success perceived by using practices or factors.

5.3.3 Initial Survey Validation, Ethical Clearance, and Pilot Testing



Initial survey validation

The first version of the survey was handed to the thesis study leaders in a Word document for their scrutiny. This was not intended as a validation step, but rather to check the understanding and readability of the survey. Problems that rose from the discussion were among the following: (1) survey was too long, (2) answers should be arranged in alphabetical order, (3) ambiguous word choices, (4) unclear intentions of questions, (5) the Likert scale should be 1-4 and not 1-5, and (6) the 'I don't know' option should be included on relevant questions. The survey was revised and drafted again.

Ethical clearance

The second version was submitted to the Stellenbosch infoEd Global website for ethical clearance. The Ethical Committee disapproved the application for ethical clearance on the basis that the survey needed Institutional Permission. After a meeting where the researcher explained the study in detail, it was concluded that no Institutional Permission was required for the surveys, because the survey focused on the professional opinion of the participant and not on the particular organization the participant was working for. The Ethical Committee did not request any changes to the survey and approved the process.

Pilot testing

This is the stage in the development of the survey that assists with determining the potential effectiveness of the survey (Reynolds et al., 1993). The pilot test aims to identify the shortcomings in the questions and it can provide valuable insight for researchers (Teijlingen et al., 2001). Although researchers report that changes were made to the questionnaire after the pilot study, few studies actually indicate what the feedback was or

what changes were made. Teijlingen et al. (2001) summarized reasons for conducting pilot tests and a few reasons related to this study: assessing the feasibility of study, designing research protocol, assessing how realistic the study is, collecting preliminary data, identifying logistical problems that might occur, assessing the willingness to participate.

The adjustments were made to the second survey version that produced a third version of the survey. The third survey version was sent out as a pilot test to 6 participants. The participants that were selected, occupy the following positions: two Stellenbosch lecturers, two Stellenbosch industrial engineering master's degree students, and two engineering graduates working in different industries (one from a software development company and the other from an investment bank).

The selection criterion for the pilot test was that the participant had to at least have an engineering undergraduate qualification. The pilot test's major objective was to be easily understandable to the participants, even if they are not specialized project portfolio managers. The participants were asked the following questions in the email:

(1) How long did it take you to fill in the survey?
(2) Did you notice any spelling mistakes or errors?
(3) Were any of the questions unclear?
(4) Was the survey easy to use? If not, why?
(5) Additional comment:

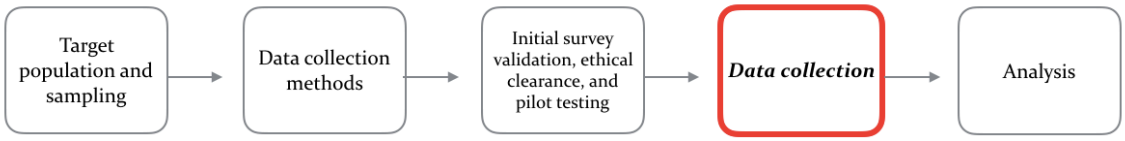
Feedback was positive from the pilot testing participants. On average the test took the participants 10 minutes and it was fairly easy to fill in. However, the following concerns were raised:

- Not all the industries were covered in question 1, for example education.
- One participant was unsure if there was a formal project portfolio manager within the company; to make the study more accurate an 'I don't know' option was added to question 3.
- The participants suggested a description for each type of success in question 5.
- A spelling mistake was found in question 7.

- Some questions were not clear and did not fit the selection of answers provided.

The survey was adjusted and improved according to the suggestions made by the pilot testing participants. The survey was resubmitted on Survey Monkey as the final survey.

5.3.4 DATA COLLECTION



Final survey process

The intention with the final survey was to invite a large number of project portfolio managers to participate. Organizations that were identified as likely candidates to make use of project portfolio management, were emailed and telephoned and asked to participate. Another method was to approach organizations through personal connections (acquaintances within organizations). A copy of the email, containing the cover letter and link to the survey that was sent to the organizations, can be found in Appendix B2.

A list of 1942 participants was asked to participate in the survey and they were sent a link. Of the 1942 participants asked to participate, 342 responses were completed, for a response rate of 17%. It was decided that the number of responses was sufficient for this study. The survey was uploaded on 15 August until 15 September (33 days) and it reported 342 responses. The completed questionnaires' data was captured and preprocessed using Microsoft Excel.

Figure 23 below shows the response rate for the different industries. The top five industries, according to response rates, were analysed in more depth.

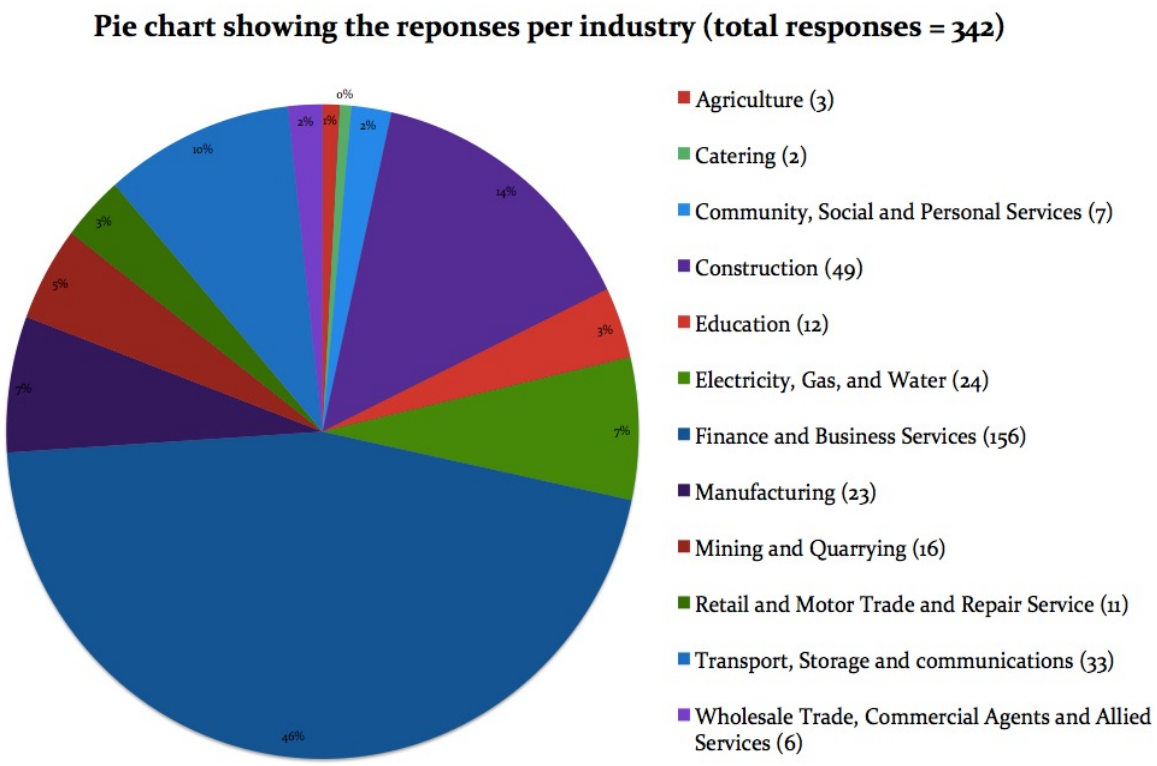
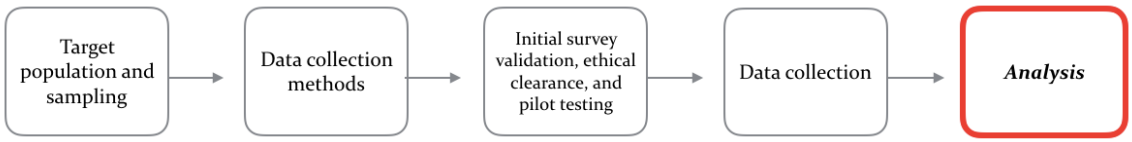


Figure 23: The divisions of response rates from each industry

5.3.5 ANALYSIS



According to Mouton (2008), data analysis inspects the various relationships between concepts, constructs or variables, to identify patterns and trends, or to establish themes. Different techniques are used to analyse data, depending on the objectives that the study wants to reach. After data is collected, it needs to be prepared and then analysed. Data extracted from answered questionnaires need to be prepared, by making it readable and able to manipulate by computer software.

The data needs to be validated, edited, coded, entered, and cleaned during the preparation stage (Hair et al., 2000). This study received numerical responses, through the online survey, that were entered into Microsoft Excel for further processing.

The data was consulted with Prof Nel who works as a statistical consultant at the University of Stellenbosch. Prof Nel helped to analyse the data and advised the author on how to interpret the results. The methods and formulas used were according to Prof Nel's professional recommendations.

Descriptive Statistics

Descriptive statistics is the procedure that summarizes, organizes, graphs, and describes quantitative information (Cramer and Howitt, 2004). This is a means for the researcher to describe the variables numerically.

It is sometimes advised to use the median when analysing Likert scale data, this study uses a more in depth analyses by using the ANOVA test. According to Prof Nel, the results from the ANOVA test is more suited for this study and represent the differences 'much better' than the results from a median test. Prof Nel's advice is confirmed by Boone et al. (2012) who suggest the following methods be used for a Likert-Scale data set: mean, Standard deviation, Pearson's r, ANOVA, t-test, and regression. This study used the descriptive statistics in the Table 35 below:

Table 35: All the statistical analysis formulas used to analyse the quantitative data

Analysis type	Description	Notes
Median	The most frequent response.	NA
Mean	Otherwise known as the average (the sum of all the samples, divided by the number of samples).	NA
Standard deviation	Expresses how much the members of a group differ from the mean value for the group.	NA
Confidence interval	A range of values thus defined that there is a specified probability that the value of parameter lies within it.	This study uses a 95% confidence level.
One-way ANOVA F-test	Measures how far the data is scattered from the mean and can assess the equality of variances.	$\propto$ - Significance level If $p<0.05=\propto$ then the variances differ significantly.
Kruskal-Wallis test	This is a nonparametric test and is used when the one-way ANOVA assumptions are not met. It assesses for the significant differences between two or more groups of an independent variable on an ordinal or continuous dependent variable.	Used when the variances differ significantly ($p<0.05=\propto$). Also measured against significance level.
Bootstrap test	A range of values thus defined that there is a specified probability that the value of parameter lies within it.	To clearly indicate the difference between variances by donating an 'a' or 'b' in the graphs if there are significant differences in answers.

Correlation analysis

The term correlation, among scientific researchers, generally refers to an association, connection, or any type of relationship that links or corresponds variables (Mukaka, 2012). At a Royal Society meeting in London, Karl Pearson introduced the modern correlation techniques in 1895. Pearson illustrated his statistical model using Darwin's evolution and Galton's heredity. A correlational study is a quantitative method that determines the relationship (if any exist) between two or more quantitative variables from the same group of subjects. A correlation study examines how variables are naturally related without the attempts to alter or change them. Correlation research looks at the degree of the relationship and not at the cause of the effect that one variable has on another. Through a

dimensionless statistical representation, called the correlation coefficient, it is deduced how closely two variables co-vary; variation can be from +1 (positive correlation) through 0 (no correlation) to -1 (negative correlation). Figure 24 below shows how the relationship would be represented graphically:

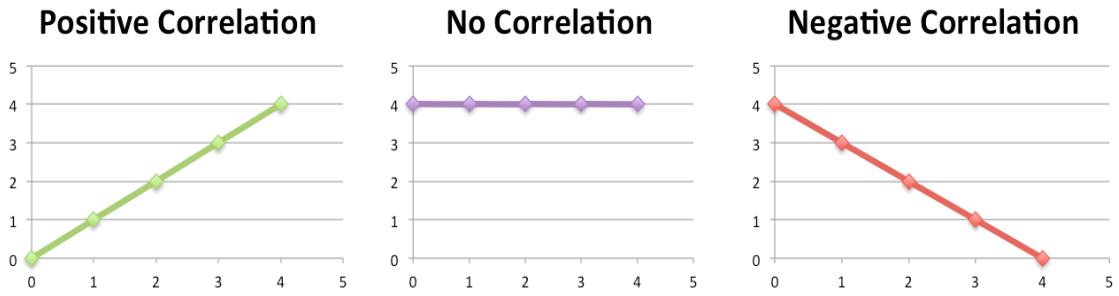


Figure 24: Different correlation results

According to Mukaka (2012), correlation types are mainly based on two types of correlation coefficients: the widely used Pearson's product moment correlation coefficient, and the rank correlation coefficient by Spearman. The types of variables being studied, determine the correlation coefficient needed for the study.

Pearson's correlation coefficient:

The Pearson's product moment correlation is the most frequently used method to measure a relationship. This r correlation is widely used in statistics to determine the degree of the relationship between linear related variables. This coefficient is affected by extreme values, which might dampen or overstate the strength of the relationship. Pearson's r correlation requires both variables to be normally distributed. Assumptions could include homoscedasticity and linearity: homoscedasticity assumes data is normally distributed around the regression line, and linearity assumes a straight-line relationship between the variables.

$$r = \frac{\sum(X - \bar{X})(Y - \bar{Y})}{\sqrt{\sum(X - \bar{X})^2 \sum(Y - \bar{Y})^2}}$$

Spearman's rank order correlation

This method evaluates the monotonic relationship between two continuous or ordinal variables. A monotonic relationship is when variables tend to change together but not necessarily at a constant rate. This coefficient is less based on the raw data, but more on the ranked values. Spearman's correlation coefficient is appropriate when variables are measured on a scale that is ordinal. The Spearman method does not make any assumptions about the distribution.

$$r_s = 1 - \frac{6 \sum D^2}{n(n^2 - 1)}$$

D is the difference between a pair of scores and n is the number of pairs of ranks.

This study considered the advantages and disadvantages of correlation studies before choosing it as a main method to interpret the data gathered.

Advantages

- Useful for scientific hypothesis generating
- Quick and easy to do
- Can study a wide range of variables and their interrelations
- Can collect a lot of information from many subjects at one time

Disadvantages

- Can determine if there is a relationship between variables but cannot determine the direction of the relationship
- Confounding variables cannot be controlled or disregarded
- Are not able to show cause and effect (no experimental manipulation)
- Relationship may be accidental or due to a third unmeasured factor, common to the two variables measured

With the survey set up, a correlation study was best fitted to interpret the results. Spearman's correlation method and a Likert scale were used in this study, since the data was not continuous.

Inferential Statistics

Inferential statistics are used to determine the significance levels between the dependent and independent variables. It refers to the conclusions drawn from a sample data set compiled with the statistics used.

5.3.6 SURVEY QUESTIONS

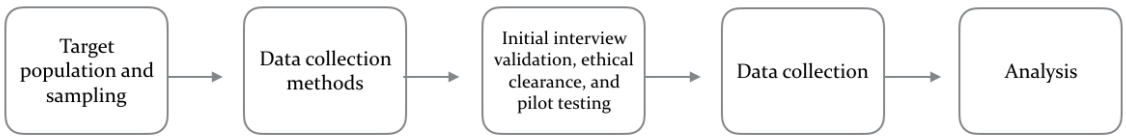
After careful considerations and planning, the survey was constructed. Refer to Appendix B1 for the survey questions as it was displayed to the participants. The following Table 36 explains each question, the purpose, and from which section the literature supports the question.

Table 36: Survey questions, purpose, and related section

#	Question	Explanation and purpose	Section
1	Under which industry is your organization classified (according to the Standard Industrial Classification)?	This question intends to classify the results according to the following ten industries: agriculture; catering, accommodation, and other trades; community, social, and personal services; construction; education; electricity, gas, and water; finance and business services; manufacturing; mining and quarrying; retail and motor trade and repair services; transport, storage, and communications; wholesale trade, commercial agents and allied services	3.6.2
2	How many full-time employees work for your organization?	This is to classify the organizations according to the size: small, medium, and large	3.6.2
3	Does your organization have an official project portfolio manager?	This is to compare the practices used and problems faced between organizations that have portfolio managers and those that do not.	3.5
4	What is your position within the organization?	This question aims to classify the results according to different management levels: strategic-, portfolio-, programme-, project-, and other management.	3.5
5	How, would you say, does your organization rank the following project portfolio management success criteria?	This question aims to identify the importance and any differences in ranking the PPM success criteria, using a Likert scale (1-4). The four success criteria selected for this study are the following: the portfolio is aligned with the organizational strategy; the portfolio is balanced; the average single-project success; the use of synergies.	3.10.2
6	How successful do you perceive your organization's project portfolio management?	This aims to quantify the perceived success of the organization's PPM on a Likert scale (1-4)	3.10
7	Single-project level - this refers to the characteristics, activities, and decisions made on a single-project level.	This aims to question the 'perception' and 'use' of practices that were constructed in Chapter 4's framework for 'single-project level'. A Likert scale (1-4) was used to quantify these results. The option 'I don't know' was given to the question that examines the 'use' of practice.	3.10.3
8	Multi-project level - this refers to the characteristics, activities, and decisions made on a portfolio level (i.e. a combination of single-projects).	This aims to question the 'perception' and 'use' of practices that were constructed in Chapter 4's framework for 'multi-project level'. A Likert scale (1-4) was used to quantify these results. The option 'I don't know' was given to the question that examines the 'use' of practice.	3.10.3

9	Links to strategy - this refers to the ability to link the projects and the organizational strategy.	This aims to question the 'perception' and 'use' of practices that were constructed in Chapter 4's framework for the 'link to strategy'. A Likert scale (1-4) was used to quantify these results; the option 'I don't know' was given to the question that examines the 'use' of practice.	3.10.3
10	Project information - this refers to the availability and quality of information that the portfolio managers need to make effective decisions.	This aims to question the 'perception' and 'use' of practices that were constructed in Chapter 4's framework for 'project information'. A Likert scale (1-4) was used to quantify these results. The option 'I don't know' was given to the question that examines the 'use' of practice.	3.10.3
11	To what extent do the following project portfolio management problems exist in your organization?	Six problems areas were identified in Chapter 3. This question aims to quantify the degree of the problems that are faced by practitioners, by using a Likert scale (1-4)	3.7
12	This study is made up of two phases; the first phase is the collection of data through surveys (current) and the second phase is the collection of data through interviews. Would you be willing to participate in the second phase of interviews?	To better understand and interpret the results, interviews benefit the study; this question asked if the participants were willing to participate in the interview process.	5.4

5.4 QUALITATIVE RESEARCH DESIGN (INTERVIEWS)



The objective of the second phase is to expand the scope, validate, and get a better understanding and insight into the results obtained in the first phase of surveys. Interviewing is a primary way of collecting qualitative data (Stuckey, 2013). The findings obtained from the first phase initiated a logical set of questions to be asked in the second phase. The second phase addresses the objectives 6, mentioned in Chapter 1 and the objectives mentioned in the beginning of Chapter 4. Stage two may be defined as qualitative as the objectives aim to specifically examine and reflect on the experiences and perceptions of individuals (Given, 2008; Vogt, 2005).

Background on interviews

Interview styles range, but primarily there have been three types of common interview techniques used: (1) structured, (2) semi-structured, and (3) unstructured.

STRUCTURED INTERVIEWS

When orientated correctly, structured interviews often produce quantitative data (DiCicco-Bloom and Crabtree, 2006).

SEMI-STRUCTURED INTERVIEWS

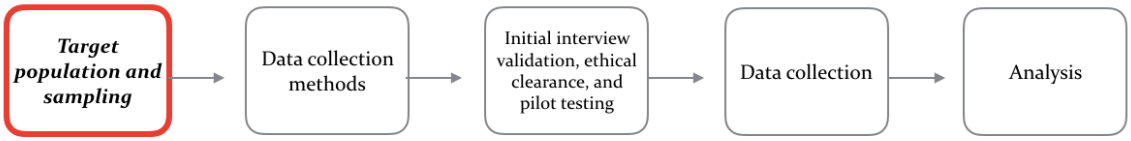
Often the sole data sources for qualitative data research projects are semi-structured interviews. The researcher sets an outline for the topics to be covered, but the responses of the participant determine the direction of the study (Stuckey, 2013). The semi-structured interview is flexible and could cover a broader scope than the structured interview approach.

UNSTRUCTURED INTERVIEWS

Although no interview can truly be unstructured, some have less guidance than others. Unstructured interviews originate from the ethnographic tradition of anthropology (DiCicco-Bloom and Crabtree, 2006). Data is gathered through participant observation and through recording data by joining in activities and/or observing from the sidelines.

The semi-structured interview approach was chosen for this study for its ability to control the topics of the interview, while allowing the conversation to be flexible. The interviewer aimed to limit intervention, to limit the bias views that could influence the participants' perspectives and observations.

5.4.1 TARGET POPULATION AND SAMPLING



Target population

This study's target population was defined as organizations making use of PPM practices in South Africa. However, the diverse nature of the scope has resulted in various answers from different industries and management levels. The target populations for the interviews were narrowed down to four different types of managers: strategic, project portfolio, program, and project managers.

Sampling

As explained in the previous section (quantitative) under sampling, the sample was determined using the traditional approach. The same process to select the survey sample was used to select the interviewees. Again, a judgment sampling method was seen as the most fitting method, given that the respondents from the previous stage or surveys determined the appropriate participants for the qualitative stage.

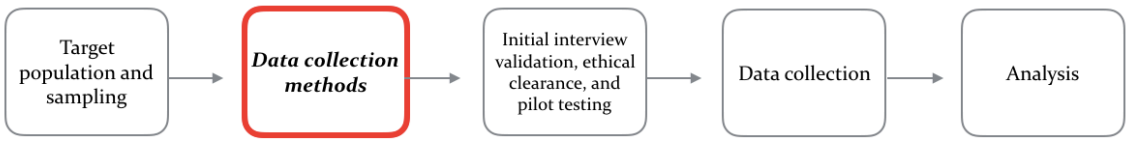
The desired sample size for the qualitative validation was determined to be 5 participants. As with the quantitative analysis, the greater the sample size, the greater the confidence in the results obtained. Yin (1990) states that in a multi-case qualitative situation when cases are completely different, or when a high degree of certainty is not needed, then only two or three cases are necessary. On the other hand, when the differences between the cases are subtle and/or more certainty is needed, then five or six cases could be necessary.

This study is based on portfolio management and ideally it would be well suited to the study if portfolio managers were interviewed for each industry. However, the study only focused on five major industries and of those five major industries not all portfolio managers agreed to be interviewed. The best-suited candidates were chosen for the interviews. The criteria for the candidates was based on (1) position within the company, (2) responsibilities within the company, (3) experience in the field of portfolio management, and (4) academic history credentials and completed certificates (e.g. PRINCE2). Table 37 is a summary of participants and responses.

Table 37: Summary of participant contributions

Total responses	**342**
Participants asked to take part in study	1942
Participants willing to be interviewed	173
Selected interviewees	4

5.4.2 DATA COLLECTION METHODS



To fulfil the research objectives 6, a qualitative means of gathering data was chosen to interpret individuals' perception and experiences. Two forms of data collection were considered for the study: *interviews* with specific managers in specific industries, and *observation* where the researcher observes the practice in an organization.

To achieve the objectives that aim to explore individuals' experience and perceptions, it was decided that the best approach was to conduct interviews. The time constraints placed on the study and the lack of the researcher's personal experience in practice would've possibly made the observation approach inaccurate and too time consuming.

The interviews in this study are used to validate the quantitative conclusions drawn from the results. The validation is done through interviewing experienced people who can give their professional opinion, motivations, and recommendations for the points under consideration. The process for validation via interviews is shown in Figure 25 below:

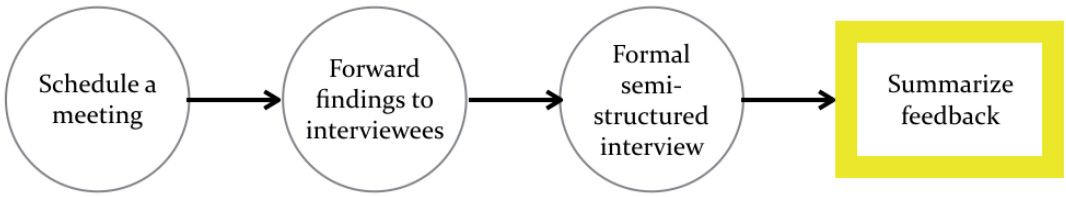


Figure 25: Interviewing process

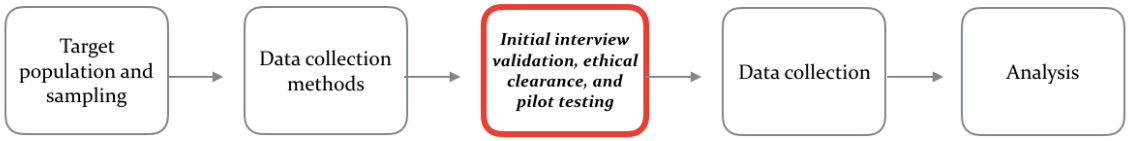
The selected participants that volunteered to be interviewed were contacted and asked for a scheduled meeting. The findings of the survey were emailed to them and a short presentation was given before the interview to minimize any ambiguity. Next the formal interview took place, where the researcher asked the interviewees questions regarding their professional opinion about the results obtained from the surveys. After the formal interview, the questions were summarized and discussed with the researcher's supervisors before the final conclusions were drawn.

Developing the research instrument

Utilizing the semi-structured interviewing approach, topics were written down, but the interview was to an extent dependent on the answers obtained from the interviewee. The questions were structured in a similar order to the questions in the survey. The first part of the interview was to find out how important PPM is in the interviewee's organizations and to what extent it is used. The second part was divided into four, asking the interviewee if he/she agrees with the findings on the factors that influence the success criteria: (1) single-project-level characteristics and activities; (2) multi-project level characteristics and activities; (3) links between projects and strategy; and (4) the availability of project information. The final section was to understand the difficulties faced by project portfolio managers and what they perceive to be the reason for these difficulties arising.

This study used the microphone application of a phone as a means of recording the interviews.

5.4.3 Initial Survey Validation, Ethical Clearance, and Pilot Testing



Initial interview validation

Before the interview questions could be constructed, the results from stage 1's online survey had to be collected, analysed, and scrutinized. Only after all the methods and conclusions were drawn from the data, could the interview questions be set up.

The first version of the interview questions was sent in a Word document to the study leaders for their opinion. Again, this step was not intended as a validation step, but rather to check the understanding of the questions. The suggestions made by the study leaders

were among the following: (1) the questions should link back to the objectives, (2) the questions needed to be simplified, and (3) change word selection.

After the corrections were made, the interview questions were again sent to the study leaders for their final approval.

Pilot testing

The pilot test was done with mock interviewing individuals. The only suggestion that was given from the mock interview was to simplify the questions and to choose different wording. The pilot testing helped to refine the questions for the interview.

5.4.4 DATA COLLECTION

The individuals selected for interviews were sent a cover letter, thanking them for taking part in the interview, as well as an interview guide to give them a chance to formulate their responses (refer to Appendix C1 & C2). This was to prevent the interviewees from striking a 'blank' or being unprepared.

The individuals interviewed are summarized in Table 38 below:

Table 38: A summary of the individuals that were interview.

Interviewee Name	Industry	Experience	Method of interview
Respondent 1	Project Management Educator, especially in the Finance and Business Services industry	Respondent 1 is a Project Management trainer who has much experience	Cell phone interview
Respondent 2	Construction	Programme manager and Business consultant • Managing Successful Programmes (MSP) Diploma • PRINCE2 practitioner • MSP Practitioner • Project Management Diploma (PMBoK)	Cell phone interview
Respondent 3	Electricity, Gas, and Water	Project Management Office, head of department • Project Manager Professional (PMP) • Master of Science (MSc) focus on project management	Face-to-face
Respondent 4	Transport, Storage, and Communications	Portfolio Manager • PMP	Cell phone interview

The researcher personally conducted the interviews. Each interview was recorded and the researcher took additional notes during the interview. Each interview was transcribed for analysis after the interview took place. After all the interviews took place, further analysis was performed.

5.4.5 ANALYSIS

The analysis of the data obtained from the interview aims to bring together loose ends and give explanations to the answers from the quantitative surveys' responses. The analysis inspects the relationships between concepts and tries to identify if any pattern exists.

Reliability and Validity

As discussed under quantitative methods, reliability and validity is an important part in any research study. For the interview approach in qualitative research, there is still a debate about validity. Dyer and Wilkins (1991) state that the question is whether or not a researcher should give priority to the richness of knowledge or to the accuracy of the measurements. It is difficult to assess if the instruments of the interviews are measuring what is supposed to be measured (Thiétart et al., 2001). These interviews are based on quantitative findings and will put the emphasis on the richness of knowledge.

Although validity and reliability is not as easy to determine in qualitative research as in quantitative research, there are a few pointers from Thiétart et al. (2001) that the researcher considered to improve the validity of the research. It becomes harder to determine validity when dealing with opinions and where there are no criteria of validity.

Thematic analysis

Relevant themes were identified in the interviews and integrated with the results from the surveys as shown in Chapter 7.

5.4.6 INTERVIEW QUESTIONS

Table 39 below is a summary of the questions and the related sections that developed the reasoning for the question. The questions are aimed to achieve the objectives that were developed for this thesis.

Table 39: Interview questions and related sections

#	Interview Question	Related section
1	Industries rated portfolio balance as one of the lower success criteria, yet overall it has the strongest correlation. Why do you think this is? (Refer to Table 41 and Table 42)	6.1
2	Although single-project success is ranked the highest, the correlation to portfolio management success is the weakest. What underlying dynamics may cause this? (Refer to Table 41 and Table 42)	6.1
3	The 'perception' is that practices of Project Information have a high influence on the success of Portfolio Management, yet the practices are reported not to have been often in 'use'. Why is this and how could organizations improve this? (Refer to Table 45 below shows the difference in 'perception' of importance and 'use' of practices using the means in ANOVA analysis. Using the heat mapping techniques, it is clear which practices are 'perceived' higher than others and which practices are 'used' more than others. Table 45)	6.2
4	The organizations with portfolio managers face fewer problems, according to the means taken from the six problem areas (refer to Table 48). The 'perception' and 'use' of multi-project level (portfolio level) practices are low compared to the other practices (refer to Table 45), yet they do have good correlations with the portfolio success (refer to Table 47). Why, would you say, is there such a gap in the 'use' and 'perception' of portfolio management practices?	6.2
5	All the industries struggle with allocating resources effectively. Why is this a major problem and what can be done to solve it? (Refer to Table 48)	6.3
6	There seems to be a difference between top and middle management with the problems faced. What could be the explanation for this? (Refer to Table 49)	6.3
7	The results show that organizations with a portfolio manager in their organization, rate the problems identified in this study lower than those organizations without a portfolio manager (refer to Table 50). What are the major benefits that a portfolio manager can bring to an organization?	6.3

CHAPTER 6 - RESULTS

In Chapter 4, the conceptual framework was presented, followed by Chapter 5 that explained the process of data collection through quantitative (surveys) and qualitative (interviews) means of data collection. This chapter, as with Chapter 5, is divided into two major parts, quantitative and qualitative. Both these parts address three topics as seen in Figure 26 below. Table 40 shows the questions that were answered in this Chapter. The results are followed by recommendations to address the uncertainties in the data findings.

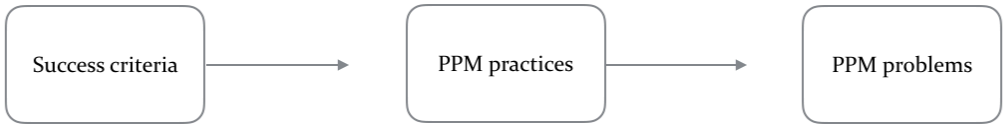


Figure 26: Sections of the results

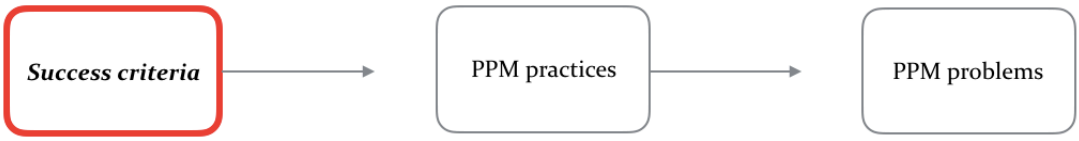
Table 40: the main questions addressed by the results

This section aims to answer the following main questions		Sections questions will be addressed
1	a) How do different industries rate each success criteria? b) How do the different success criteria correlate with the perceived success of different industries?	6.1 Success criteria
2	a) How do the different management levels rank the success criteria? b) How do the different success criteria correlate with the perceived success of the different levels of management?	6.1 Success criteria
3	a) How do the perception of practices' influence and the uses of practices differ, according to different industries? b) How do the perception of practices' influence and the uses of practices differ, according to different management levels? c) How do the uses of practices correlate with the portfolio success?	6.2 Practices
4	a) What are the problems faced by the different industries? b) What are the problems faced by the different management levels?	6.3 Problems
5	How do the problems faced by the organizations with PPM differ from the problems faced without PPM?	6.3 Problems
6	What comments did the interview respondents have on 'the success criteria' results?	6.4 Success criteria
7	What comments did the interview respondents have on the 'best practices' results?	6.5 Practices
8	What comments did the interview respondents have on the 'problems' results?	6.6 Problems
9	What were the main uncertainties from the data findings and how did the interviewees address these uncertainties?	6.7 Recommendations
10	What recommendations can be made to improve on these uncertainties?	6.7 Recommendations

QUANTITATIVE RESULTS

The quantitative results were analysed using the descriptive statistics as explained in section 5.3.5. It is important to note that although the median analysis is often used for a Likert scale study, this study purposefully has a more in depth investigation approach by making use of descriptive analysis tools such as: median, mean, Standard deviation, Confidence interval, One-way ANOVA F-test, Kruskal-Wallis test, and the Bootstrap test. The medians were also calculated and taken into consideration for the analysis. Please refer to the provided CD for all the data findings.

6.1 QUANTITATIVE - SUCCESS CRITERIA



6.1.1 QUESTION 1

a) How do the different industries rank the following project portfolio management success criteria?

The success criteria must be distinct to the organization's strategy and thus it is important to choose the appropriate success criteria. It is sometimes advised to use the median approach when using a Likert scale, but to get a more accurate answer, this study uses the tests mentioned in section 5.3.5. Table 41 indicates the similarities or differences between the rankings of the four identified success criteria among different industries, using the means of the industries.

Table 41: Ranking success criteria according to different industries, using a Likert scale (1-4), to compare the means

	All industries N= 337	Construction N=49	Finance and Business Services N=156	Transport, Storage and Communications N=33	Electricity, Gas, and Water N=24	Manufacturing N=23	F	p	Kruskal Wallis
1. The portfolio is aligned with the organizational strategy	2.74	2.612	2.782	2.696	2.625	2.696	1.11	0.35	0.43
2. The portfolio is balanced	2.623	2.592	2.679	2.576	2.417	2.565	0.88	0.53	0.66
3. The average single-project success	2.787	2.816	2.782	2.879	2.625	2.696	0.79	0.62	0.42
4. The use of synergies	2.553	2.612	2.603	2.576	2.208	2.478	1.2	0.29	0.41
Ranking sections					2.0-2.19	2.2-2.39	2.4-2.59	2.6-2.79	2.8 - 3
Ranking colour									

Table 41 is represented by Figure 27 below; the vertical bars in the graphs denote 0.95 confidence intervals. The figure indicates that the industries ranked the success criteria more or less the same. The frame graph for 'synergy' showed the most difference in means; this was confirmed by the p-value in Table 41.

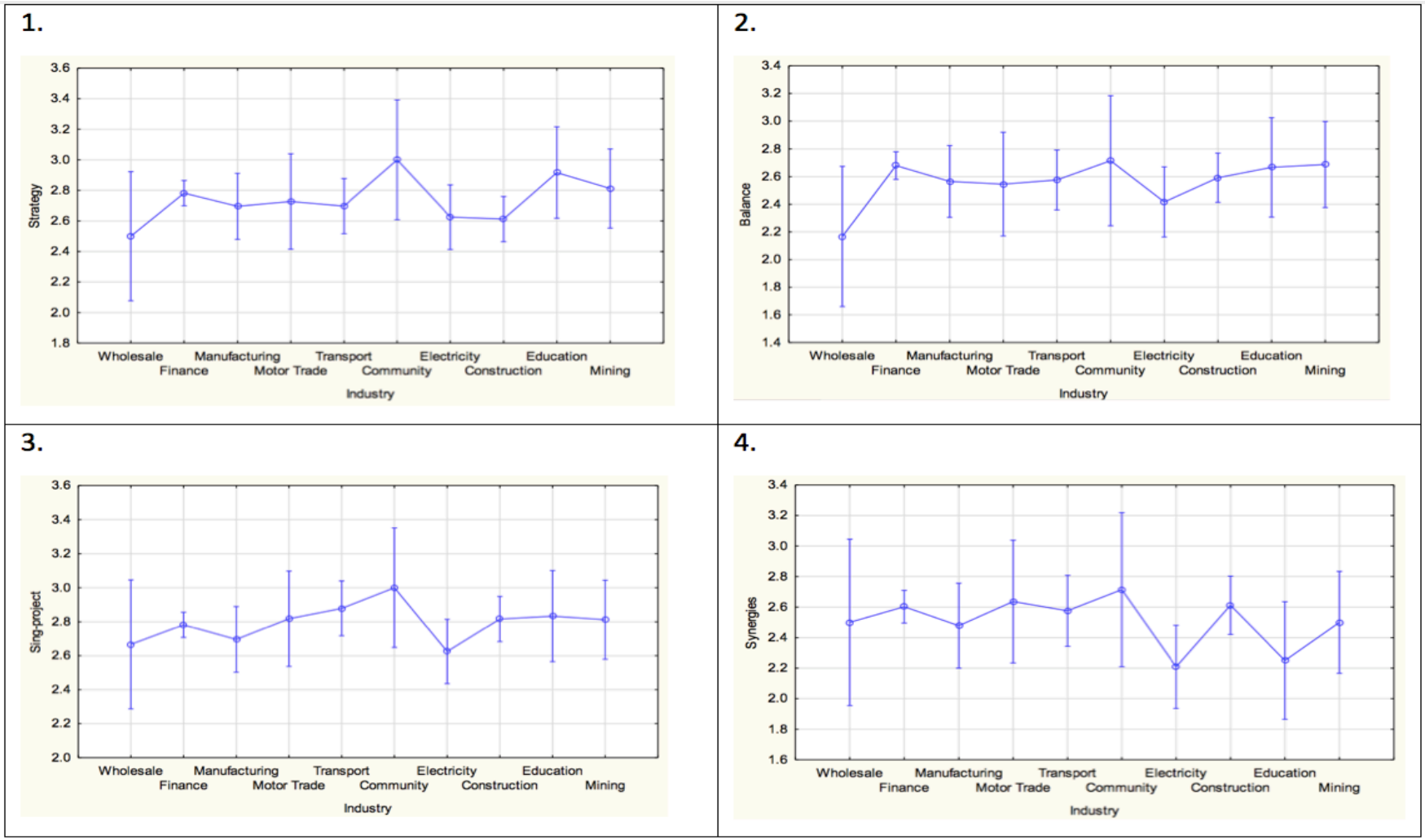


Figure 27: All industries ranking the four success criteria

b) How do the different success criteria correlate with the perceived success of the different industries?

Table 42 presents the correlations of the perceived success to each success criteria.

Table 42: Spearman's correlation coefficient (rs) between the success criteria and perceived portfolio success according to different industries

	All industries N=337	Construction N=49	Finance and Business Services N=156	Transport. Storage and Communication N=33	Electricity, Gas, and Water N=24	Manufacturing N=23
1. The portfolio is aligned with the organizational strategy	0.462	0.416	0.469	0.475	0.41	0.523
2. The portfolio is balanced	0.528	0.515	0.463	0.669	0.683	0.562
3. The average single-project success	0.321	0.090	0.28	0.096	0.615	0.322
4. The use of synergies	0.463	0.231	0.452	0.425	0.818	0.411
Intervals for ranks		0.0-0.199	0.2-0.399	0.4-0.599	0.6-0.799	0.8-1
Colour ranking						

ALL INDUSTRIES

Clearly the success is rated differently in each industry, but there were no major differences in variances since all the p-values were greater than the significance level (0.05=∝). The five major industries are compared in Table 41 and Table 42. Overall 'average single-project success' was the highest rated criteria, but also showed the weakest correlation with portfolio success. This leads to the question: 'Although single-project success is ranked the highest, the correlation to portfolio management success is the weakest. What underlying dynamics may cause this?'

The opposite is true for portfolio balance success criteria; industries did not rate portfolio balance as the most important success factor, yet it had the strongest correlation overall. This poses the question: 'Industries rated portfolio balance as one of the lower success criteria, yet overall it has the strongest correlation. What are the reasons for this?'

A possible reason for these trends could be because of misperception or a lack of knowledge among industries. These industries might use other types of success criteria than the four identified in this thesis.

INDUSTRIES (QUESTION 1 A&B)

Construction – The 'single-project success' was overall ranked the highest success criterion, which initially was thought to be a result of the feedback from a large number of project managers (23 out of 49) in this industry. However, investigating this further disproved the initial theory showed the opposite to be true; the median (median=3) for the project managers was '3' whereas the median for all the other management levels was '4'. Although ranked the highest, the correlation of the 'single-project success' to the 'perceived portfolio success' was by far the weakest. The strongest correlation was found to be the balanced portfolio success criterion.

Finance and Business Services – This industry has two criteria that are highly rated, (1) strategy alignment, and (2) average single-project success. The strongest correlation to the portfolio success however, is the strategy alignment, and the weakest is average single-project success. This industry's participants had the smallest differences in ranking, as can be seen in the graphs. The financial industry has the shortest vertical bars for the confidence interval of 95% (refer to Figure 27).

Transport, Storage and Communication – For this industry the highest average rating was the average single-project success. Similar to the construction industry, the initial thought was that this could be a result of a high project management response rate, yet the median (median=3) for the project managers, compared to the other management levels, was the same. The correlations with portfolio success shows that average single-project success also has the weakest correlation. Although portfolio balance was rated the lowest, it had by far the strongest correlation to portfolio success.

Electricity, Gas, and Water – This industry had overall the strongest correlations to the success criteria proposed. The lowest rated success criterion, which is the use of synergies, has the strongest correlation to the portfolio success. This industry has three very strong correlations: (1) use of synergies, (2) portfolio balance, and (3) the average single-project success. This could be due to the success criteria identified in this study, to be similar to the success criteria that were used in this industry.

Manufacturing – The highest rated success criterion – average project success – had the weakest correlation to the portfolio success. The second lowest rated criterion – portfolio balance – had the strongest correlation.

6.1.2 QUESTION 2

a) How do the different management levels rank the following project portfolio management success criteria?

As with Question 1, the four success criteria that were identified in the study were ranked by participants who have different management roles. Table 43 considers the difference across the industries, by determining the means of the success criteria according to the different management levels.

Table 43: Ranking success criteria using a 1-4 Likert scale according to different management levels, to obtain the mean results

	All management N=342	Top Management N=77	Portfolio Management N=45	Programme Management N=62	Project Management N=110	Other N=48	F	p	Kruskal-Wallis
1. The portfolio is aligned with the organizational strategy	2.74	2.831	2.822	2.677	2.673	2.75	1.54	0.19	0.06
2. The portfolio is balanced	2.623	2.753	2.711	2.548	2.527	2.646	1.95	0.1	0.1
3. The average single-project success	2.787	2.805	2.778	2.677	2.809	2.854	1.18	0.32	0.58
4. The use of synergies	2.553	2.675	2.489	2.484	2.527	2.563	0.93	0.45	0.32
Ranking sections					2.0-2.19	2.2-2.39	2.4-2.59	2.6-2.79	2.8-3
Ranking colour									

The management levels in Table 43 show that there are some differences in the ranking of the success criteria. The management levels are from different industries and the p-value indicates that there are no significant differences in the ranking of the success criteria among management. Figure 28 shows the success criteria rankings in the 95% confidence level graphs between the management levels.

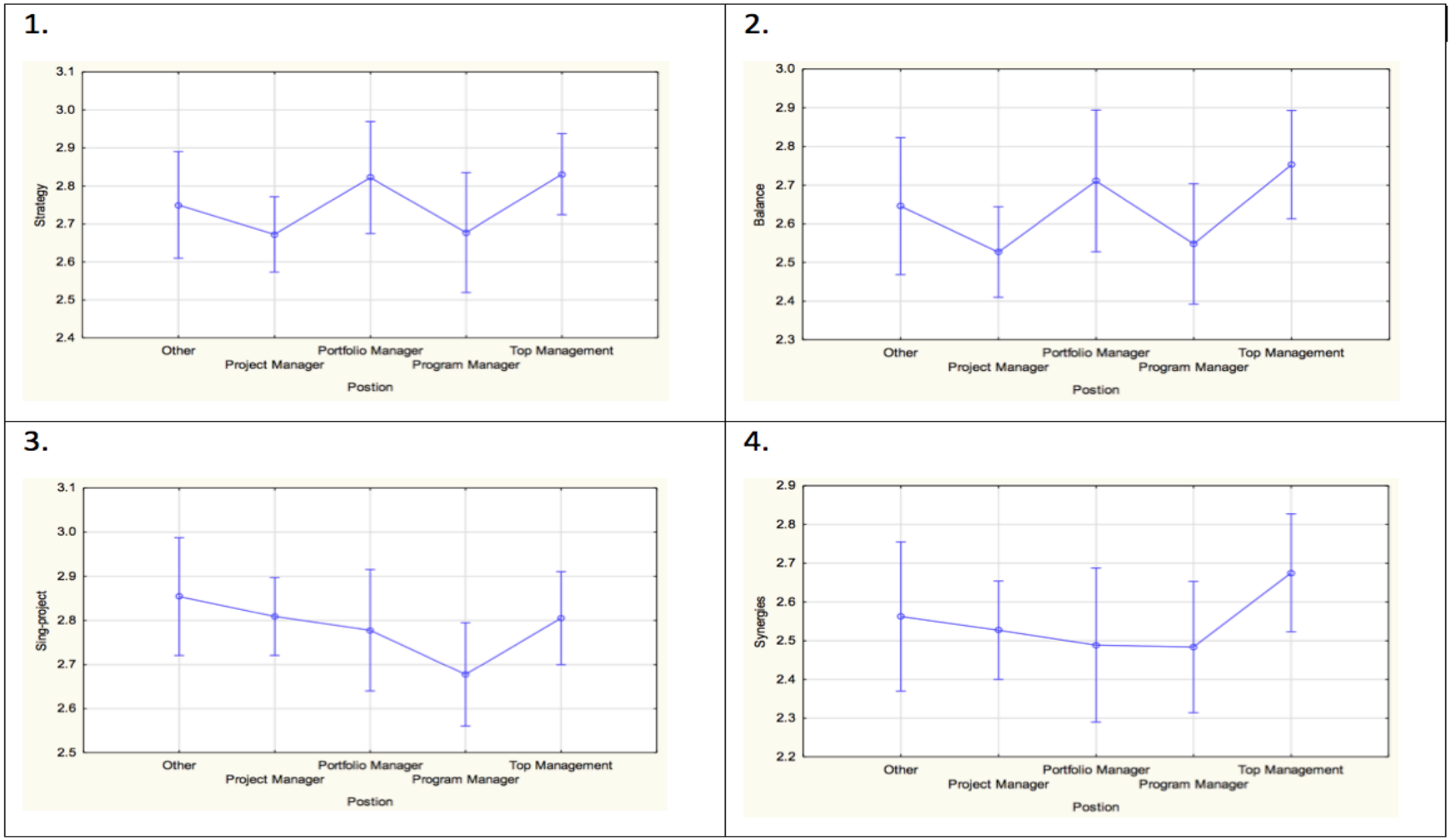


Figure 28: All management levels ranking the four success criteria

b) How do the different success criteria correlate with the perceived success of the different levels of management?

As with the correlation in Question 1b, Table 44 below also shows how all the different management levels rated the different success criteria.

Table 44: Spearman's correlation coefficients (rs) between the success criteria and perceived portfolio success according to different management levels

	All Management N=342	Top Management N=77	Portfolio Management N=45	Programme Management N=62	Project Management N=110	Other N=48
The portfolio is aligned with the organizational strategy	0.462	0.257	0.252	0.56	0.54	0.488
The portfolio is balanced	0.528	0.462	0.321	0.552	0.583	0.519
The average single-project success	0.321	0.271	0.314	0.36	0.317	0.34
The use of synergies	0.463	0.298	0.458	0.511	0.553	0.366
Intervals for ranks		0.0-0.199	0.2-0.399	0.4-0.599	0.6-0.799	0.8-1
Colour ranking						

ALL MANAGEMENT

The strongest overall correlation to the portfolio success was 'portfolio balance'; the weakest was 'average single-project success'. Management levels rated the success differently, but overall there were no major differences in variances since all the p-values were greater than the significance level ($0.05 = \propto$). However, the p-values for the management levels were smaller than the p-values for the different industries; this could suggest that the way in which success criteria are chosen for portfolios, is more industry related than position related. Comparing Figure 28 and Figure 27 shows the difference in variance.

ALL MANAGEMENT (QUESTION 2 A&B)

Top management – Although 'single-project success' and 'strategy alignment' were rated the highest, the correlations indicated that they were the two weakest for that management level. Top management is mostly involved with the organization's strategy,

which could lead them to rate the criteria higher. However, the top management correlates low with the success criteria. This poses the question: 'Is there a gap in knowledge and understanding of success criteria among top- and other management levels management?'

Portfolio management – As stated in Chapter 3, the portfolio manager's aim is to align the organization's projects to the organizational strategy; therefore it is expected of the portfolio managers to rate 'strategy alignment' as the most important success criteria. Although 'strategy alignment' was ranked the highest, it had the weakest correlation to portfolio success. Top- and portfolio managers have about a similar rating for all the success criteria. This could possibly be because of the frequent communication between top and portfolio managers or because portfolio managers, are in top managerial roles and there is a similar perception among those roles as to what is important. The strongest correlation in the results of the portfolio managers are the 'use of synergies', which also plays an important part when it comes to the role that the portfolio manager has to take on, by making sure the processes run efficiently and effectively.

Portfolio managers also have the most differences concerning the rating of the portfolio success criteria, as seen in Figure 28, where the vertical bar is overall longer than those of the other management levels. This could be due to the portfolio managers that are adapting the portfolio to the specific needs of their organization and industry.

Programme management – This level of management rated 'average single-project success', as one of the highest criteria, but the correlation to this is by far the weakest, compared to the other criteria for this level of management. Programme management is similar to portfolio management, but with more focus on a day-to-day basis. It is expected that programme managers would rate the two highest criteria for success as 'strategy alignment' and 'average single-project success'.

Project management– As is expected, project managers rated 'average single-project success' the highest, but similar to programme managers, the correlation results show that 'average single-project success' is the weakest correlation for this management level.

Portfolio balance has the strongest correlation to portfolio success. The results from the project- and programme managers were very similar. This could be a result of close contact or more frequent communication between the two management areas (project- and programme management); the priorities being focused in the same direction, and/or the programme- and project managers that have the same level of knowledge about the success criteria for a portfolio.

Other –This group has 'average single project success' as the highest rated success criterion, but similar to the programme- and project managers, this criterion has the weakest correlation to the portfolio success. This group has similar ratings and possibly a similar understanding of the success criteria as the programme — and project managers. This could be because of the same lack of knowledge about the right success criteria to achieve portfolio success.

6.2 QUANTITATIVE - PRACTICES

6.2.1 QUESTION 3

a) How does the perception of practices' influence and the use of practices differ, according to different industries?

Table 45 below shows the difference in 'perception' of importance and 'use' of practices using the means in ANOVA analysis. Using the heat mapping techniques, it is clear which practices are 'perceived' higher than others and which practices are 'used' more than others.

Table 45: The perception (P) and use (U) of influence on portfolio success, using a 1-4 Likert scale, according to different industries

		All industries N=342		Construction N=49		Finance and Business Services N=156		Transport. Storage and Communication N=33		Electricity, Gas, and Water N=24		Manufacturing N=23		p	
		P	U	P	U	P	U	P	U	P	U	P	U	P	U
Single-project level															
1	Use of project process models	2.901	2.922	2.694	2.717	2.878	2.947	3.152	3.25	2.917	2.958	2.783	2.913	0.19	0.155
2	Decision-making practices														
2.1	Formal pre-project planning and decision making tools selected for each individual project	3.143	3.047	3.143	3.102	3.096	2.962	3.273	3.156	3.167	3.083	3.174	3.087	0.54	0.434
2.2	Continuous formal decision making throughout project execution	3.251	3.222	3.204	3.265	3.205	3.160	3.394	3.273	3.292	3.375	3.304	2.957	0.17	0.483

3	Clearly defined goals and success measures per single-project														
3.1	Goals for costs	3.24	3.376	3.327	3.469	3.192	3.297	3.212	3.333	3.333	3.500	3.348	3.652	0.502	0.402
3.2	Goals for time	3.246	3.339	3.265	3.388	3.205	3.282	3.424	3.364	3.208	3.458	3.435	3.435	0.94	0.607
3.3	Goals for quality	3.216	3.173	3.163	3.347	3.186	3.058	3.424	3.242	3.208	3.125	3.304	3.391	0.319	0.263
3.4	Goals for client satisfaction	3.33	3.273	3.163	3.354	3.359	3.250	3.576	3.424	3.208	2.958	3.391	3.261	0.322	0.572
3.5	Goals for resources	3.012	2.853	2.878	2.938	3.019	2.890	3.212	2.909	3.000	2.792	2.956	2.565	0.291	0.707
Multi-project level															
4	Coordinated and structured links between projects	2.968	2.598	2.75	2.563	3.013	2.596	3.000	2.697	3.083	2.500	2.826	2.652	0.77	0.887
5	Formal decision making on multi-project management	3.05	2.82	2.792	2.745	3.097	2.826	3.063	2.906	3.250	2.917	2.913	2.652	0.4	0.579
6	Formal decision making on resource distribution across entire portfolio	3.112	2.763	3.042	2.958	3.103	2.845	3.344	2.750	3.167	2.391	3.087	2.522	0.599	0.19
7	Methods and PPM practices for comparing projects														
7.1	Use of financial methods (e.g. ECV, ROI, EV, NPV)	2.964	2.844	2.848	2.787	2.878	2.686	3.161	2.935	2.958	2.87	3.182	3.174	0.805	0.102
7.2	Balancing methods (e.g. risk-reward bubble diagram, traditional charts such as pie charts, mapping method)	2.499	2.306	2.413	2.318	2.417	2.24	2.656	2.438	2.696	2.409	2.739	2.304	0.563	0.32
7.3	Strategic methods (e.g. strategic bucket model, strategic check, product road map)	2.731	2.426	2.489	2.111	2.735	2.457	2.844	2.719	2.917	2.391	2.783	2.522	0.297	0.092
7.4	Right number of project methods (e.g. resource demand)	2.701	2.48	2.646	2.413	2.722	2.544	2.813	2.581	2.708	2.455	2.545	2.273	0.296	0.492
7.5	Evaluation methods adapted to the requirements of the portfolio	2.71	2.462	2.711	2.6	2.686	2.443	2.848	2.516	2.875	2.5	2.522	2.381	0.904	0.324
7.6	Stage-gate or similar type of frameworks used	2.793	2.728	2.723	2.622	2.701	2.705	2.788	2.625	2.782	2.857	2.826	3	0.12	0.001
Links between projects and strategy															
8	Alignment of projects														
8.1	Aligning each project to the strategy formulation	3.176	3.021	2.878	2.938	3.213	3.045	3.364	3.061	2.958	2.833	3.087	2.957	0.258	0.744

8.2	Reviewing and monitoring alignment of each project to the strategy	3.018	2.756	2.816	2.551	3.103	2.813	3.212	2.970	2.917	2.417	2.652	2.478	0.007	0.053
9	Alignment of portfolio														
9.1	Aligning entire portfolio to the strategy formulation	3.035	2.757	2.750	2.596	3.096	2.794	3.152	2.969	2.875	2.565	2.909	2.682	0.069	0.365
9.2	Reviewing and monitoring alignment of entire portfolio to the strategy	2.979	2.653	2.833	2.489	2.981	2.662	3.242	2.938	2.792	2.391	2.870	2.500	0.151	0.187
10	Alignment of resources														
101	Resource allocations aligned with strategy	3.001	2.607	2.816	2.644	3.038	2.601	3.063	2.656	3.000	2.542	3.136	2.565	0.601	0.738
10.2	Reviewing and monitoring the alignment of resources to strategy	2.906	2.515	2.755	2.468	2.917	2.556	3.091	2.727	2.708	2.261	3.043	2.364	0.632	0.326
Project information															
11	Decision makers have all required information on projects														
11.1	Internal information	3.345	2.968	3.327	3.102	3.359	2.936	3.333	3.125	3.292	2.917	3.304	2.870	0.986	0.656
11.2	External information	3.202	2.624	3.184	2.714	3.192	2.568	3.273	2.774	3.333	2.708	3.130	2.609	0.761	0.568
12	Information quality														
12.1	Decision makers have accurate information	3.399	2.794	3.429	2.898	3.340	2.800	3.455	2.906	3.417	2.583	3.304	2.652	0.915	0.289
12.2	Decision makers have up to date information	3.368	2.822	3.367	2.816	3.346	2.824	3.424	2.938	3.458	2.750	3.273	2.636	0.727	0.819

Intervals for ranks	2.0 - 2.249	2.25-2.499	2.5 - 2.749	2.75 - 2.999	3 - 3.249	3.25 - 3.499	3.5 - 3.749
Colour ranking for use							
Colour ranking for perceived							

As shown in Table 45 above, the different industries have just about the same 'perception' and 'use' of the identified practices. There are only two significant differences among the industries (refer to the p-values in the red boxes). For the industries, there are some general trends in each category:

(1) 'Single-project-level' practices are 'used' and 'perceived' the highest.

(2) Multi-project-level practices are not often 'used' or 'perceived' to have a high influence.

(3) 'Link between projects and strategy' are generally 'perceived' to have a good influence, but not 'used' often.

(4) 'Project Information' is 'perceived' to be very influential, but not 'used' often.

Further discussion of Table 45, Table 46, and Table 47 is summarized in section 0.

b) How does the perception of practices' influence and the use of practices differ, according to different management levels?

Similar to Question 3a, this table compares the 'perception' and 'use' of practices, but it is according to the different industries' means in the ANOVA test.

Table 46: The perception (P) and use (U) of influence on portfolio success, using a 1-4 Likert scale, according to different management levels

		All management N=342		Top Management N=77		Portfolio Management N=45		Programme Management N=62		Project Management N=110		Other N=48		p	
		P	U	P	U	P	U	P	U	P	U	P	U	P	U
Single-project level															
1	Use of project process models	2.901	2.922	2.935	2.842	2.978	3.044	2.984	2.968	2.845	2.850	2.792	3.048	0.679	0.553
2	Decision-making practices														
2.1	Formal pre-project planning and decision-making tools selected for each individual project	3.143	3.047	3.195	3.078	3.022	2.933	3.210	2.984	3.109	2.991	3.167	3.313	0.727	0.238
2.2	Continuous formal decision making throughout project execution	3.251	3.222	3.390	3.260	3.133	3.178	3.371	3.274	3.091	3.136	3.354	3.333	0.02	0.594
3	Clearly defined goals and success measures per single project														
3.1	Goals for costs	3.24	3.376	3.091	3.325	3.311	3.432	3.161	3.161	3.255	3.450	3.479	3.521	0.098	0.151
3.2	Goals for time	3.246	3.339	3.286	3.377	3.244	3.422	3.177	3.177	3.236	3.400	3.292	3.271	0.926	0.375
3.3	Goals for quality	3.216	3.173	3.325	3.338	3.022	3.111	3.226	2.968	3.173	3.191	3.3125	3.188	0.288	0.169
3.4	Goals for client satisfaction	3.33	3.273	3.519	3.338	3.133	3.133	3.323	3.113	3.327	3.376	3.229	3.271	0.109	0.227
3.5	Goals for resources	3.012	2.853	3.052	2.870	2.800	2.659	3.129	2.887	2.982	2.908	3.063	2.833	0.275	0.602

Multi-project level															
4	Coordinated and structured links between projects	2.968	2.598	2.922	2.714	2.889	2.622	3.177	2.532	2.907	2.541	2.979	2.604	0.281	0.69
5	Formal decision making on multi-project management	3.05	2.82	3.078	2.883	2.956	2.955	3.262	2.871	2.972	2.620	3.000	2.979	0.132	0.491
6	Formal decision making on resource distribution across entire portfolio	3.112	2.763	3.169	2.922	3.133	2.886	3.033	2.565	3.102	2.630	3.125	2.957	0.903	0.041
7	Methods and PPM practices for comparing projects														
7.1	Use of financial methods (e.g. ECV, ROI, EV, NPV)	2.964	2.844	3.053	2.947	3.022	3.022	2.919	2.677	2.875	2.638	3.021	3.196	0.687	0.01
7.2	Balancing methods (e.g. risk-reward bubble diagram, traditional charts such as pie charts, mapping method)	2.499	2.306	2.532	2.467	2.556	2.378	2.607	2.172	2.396	2.152	2.479	2.500	0.633	0.107
7.3	Strategic methods (e.g. strategic bucket model, strategic check, product road map)	2.731	2.426	2.792	2.539	2.711	2.311	2.774	2.344	2.760	2.431	2.532	2.444	0.609	2.444
7.4	Right number of project methods (e.g. resource demand)	2.701	2.48	2.701	2.539	2.689	2.489	2.710	2.295	2.745	2.450	2.604	2.689	0.921	0.255
7.5	Evaluation methods adapted to the requirements of the portfolio	2.71	2.462	2.714	2.618	2.622	2.477	2.726	2.246	2.748	2.340	2.681	2.767	0.953	0.04
7.6	Stage-gate or similar type of frameworks used	2.793	2.728	2.697	2.671	2.578	2.829	2.968	2.629	2.907	2.702	2.660	2.950	0.129	0.605
Link between projects and strategy															
8	Alignment of projects														
8.1	Aligning each project to the strategy formulation	3.176	3.021	3.211	3.143	3.222	3.289	3.177	2.790	3.118	2.944	3.208	3.043	0.919	0.026
8.2	Reviewing and monitoring alignment of each project to the strategy	3.018	2.756	3.091	2.922	3.067	2.867	2.934	2.516	2.964	2.651	3.083	2.936	0.651	0.045
9	Alignment of portfolio														
9.1	Aligning entire portfolio to the strategy formulation	3.035	2.757	3.117	3.026	3.089	2.911	3.032	2.581	2.954	2.567	3.042	2.826	0.754	0.01
9.2	Reviewing and monitoring alignment of entire portfolio to the strategy	2.979	2.653	3.000	2.844	3.111	2.844	3.016	2.475	2.889	2.515	2.979	2.689	0.622	0.055
11	Alignment of resources														
11.1	Resource allocations aligned with strategy	3.001	2.607	3.064	2.740	2.978	2.682	3.000	2.393	2.981	2.552	3.021	2.717	0.965	0.177

11.2	Reviewing and monitoring the alignment of resources to strategy	2.906	2.515	2.974	2.701	2.822	2.578	2.855	2.367	2.936	2.406	2.875	2.587	0.826	0.168
Project information															
12	Decision makers have all required information on projects														
12.1	Internal information	3.345	2.968	3.468	3.104	3.333	3.044	3.371	2.871	3.227	2.927	3.396	2.896	0.225	0.432
12.2	External information	3.202	2.624	3.260	2.671	3.244	2.733	3.258	2.581	3.101	2.556	3.229	2.660	0.582	0.714
13	Information quality														
13.1	Decision makers have accurate information	3.399	2.794	3.532	2.961	3.311	2.822	3.435	2.694	3.284	2.759	3.479	2.708	0.13	0.227
13.2	Decision makers have up to date information	3.368	2.822	3.442	2.935	3.333	2.889	3.355	2.688	3.280	2.813	3.500	2.766	0.394	0.422

Intervals for ranks	2.0 - 2.249	2.25-2.499	2.5 - 2.749	2.75 - 2.999	3 - 3.249	3.25 - 3.499	3.5 - 3.749
Colour ranking							
Colour ranking							

The different management levels surveyed showed more significant differences ($p>0.05$) in their 'perception' of importance and 'use' of practices. Most of the differences were in the 'use' of practices. This could mean that the practices used for portfolio management are more based on the management level than on the industry, because the industries use just about the same practices. The same general trends were found in each category for the different management levels, as for the industries:

(1) 'Single-project-level' practices are 'used' and 'perceived' the highest.

(2) Multi-project-level practices are not often 'used' or 'perceived' to have a high influence.

(3) 'Link between projects and strategy' is generally 'perceived' to have a good influence, but not 'used' often.

(4) 'Project Information' is 'perceived' to be very influential, but not 'used' often.

c) How do the uses of practices correlate to the portfolio success?

The 'perception' of importance and 'use' of practices vary in the four different categories. Table 47 summarizes the correlation of the different practices to the perceived portfolio success.

Table 47: The Spearman's correlation coefficients (rs) between the use of practices and the perceived portfolio success

		All industries N=342	Construction N=49	Finance and Business Services N=156	Transport. Storage and Communication N=33	Electricity, Gas, and Water N=24	Manufacturing N=23
Single-project level							
1	Use of project process models	0.5078	0.422	0.583	0.619	0.23	0.67
2	Decision-making practices						
2.1	Formal pre-project planning and decision-making tools selected for each individual project	0.547	0.611	0.547	0.656	0.642	0.608
2.2	Continuous formal decision making throughout project execution	0.431	0.393	0.433	0.357	0.353	0.673
3	Clearly defined goals and success measures per single-project						
3.1	Goals for costs	0.317	0.282	0.283	0.561	0.275	0.419
3.2	Goals for time	0.248	0.279	0.245	0.274	0.264	0.165
3.3	Goals for quality	0.486	0.173	0.501	0.592	0.362	0.573
3.4	Goals for client satisfaction	0.439	0.25	0.4	0.532	0.742	0.361
3.5	Goals for resources	0.452	0.326	0.511	0.553	0.581	0.198
Multi-project level							
4	Coordinated and structured links between projects	0.514	0.193	0.508	0.706	0.567	0.608
5	Formal decision making on multi-project management	0.489	0.325	0.485	0.504	0.56	0.688
6	Formal decision making on resource distribution across entire portfolio	0.498	0.32	0.519	0.627	0.415	0.614
7	Methods and PPM practices for comparing projects						
7.1	Use of financial methods (e.g. ECV, ROI, EV, NPV)	0.496	0.314	0.496	0.498	0.531	0.577

7.2	Balancing methods (e.g. risk-reward bubble diagram, traditional charts such as pie charts, mapping method)	0.513	0.507	0.442	0.576	0.663	0.634
7.3	Strategic methods (e.g. strategic bucket model, strategic check, product road map)	0.515	0.362	0.429	0.685	0.569	0.644
7.4	Right number of project methods (e.g. resource demand)	0.503	0.528	0.474	0.561	0.447	0.666
7.5	Evaluation methods adapted to the requirements of the portfolio	0.577	0.374	0.573	0.656	0.608	0.658
7.6	Stage-gate or similar type of frameworks used	0.414	0.392	0.444	0.48	0.246	0.764
Links between projects and strategy							
8	Alignment of projects						
8.1	Aligning each project to the strategy formulation	0.489	0.427	0.457	0.594	0.456	0.406
8.2	Reviewing and monitoring alignment of each project to the strategy	0.555	0.398	0.546	0.729	0.355	0.608
9	Alignment of portfolio						
9.1	Aligning entire portfolio to the strategy formulation	0.546	0.583	0.481	0.691	0.415	0.718
9.2	Reviewing and monitoring alignment of entire portfolio to the strategy	0.566	0.641	0.492	0.724	0.483	0.716
10	Alignment of resources						
10.1	Resource allocations aligned with strategy	0.529	0.347	0.567	0.605	0.519	0.494
10.2	Reviewing and monitoring the alignment of resources to strategy	0.506	0.418	0.515	0.555	0.379	0.569
Project information							
11	Decision makers have all required information on projects						
11.1	Internal information	0.4	0.259	0.398	0.582	0.462	0.317
11.2	External information	0.418	0.196	0.412	0.394	0.603	0.322
12	Information quality						
12.1	Decision makers have accurate information	0.424	0.161	0.338	0.598	0.633	0.528
12.2	Decision makers have up to date information	0.441	0.342	0.411	0.558	0.6	0.379

Interval for ranks	0 - 0.2499	0.25 - 0.499	0.5 - 0.749	0.75 - 1
Colour rank				

6.2.2 QUESTION 3 RESULTS DISCUSSION

SINGLE-PROJECT LEVEL

The practices that fall under this category are practices that all management levels are familiar with. The 'use' and 'perception' of importance are high because it is easy to understand the practices at this level. This study has a high number of project managers, which could lead one to believe that it justifies the high rate of 'use' and 'perception' of importance, but this is not the case. Top and portfolio management, as well as programme management's 'perception' of importance and 'use' of practice is just about the same; there are almost no significant differences in the means. The overall correlation of there practice aren't strong compared to the other categories, this does not necessarily mean that using these practices are not beneficial; the results for this category could be due to the wrong projects being chosen in the first place, this links back to not having the correct selection or success criteria.

1. **Use of project process models** - In management and industries there were no significant differences ($p>0.05$). Transport, storage, and communication industries' 'perception' of importance and 'use' of project process models have the highest means; these industries also have the strongest correlation to portfolio success and the use of process models. There were no significant differences among variances. Electricity, gas, and water industries have the weakest correlation to this practice.
2. **Decision-making practices** - Both these practices are often 'used' and overall 'perceived' to be influential, but there is a major difference in managements' 'perceptions' of importance of the practice 'continuous formal decision making throughout the project' (2.2 has a $p=0.02$). Although 'continuous formal decision making throughout the project' (2.2) has the higher rated average, 'formal pre-project planning and decision making tools selected for each individual project (2.1) has the stronger correlation to portfolio success.
3. **Clearly defined goals and success measures per single-project** – No significant variation in means across industries or management levels. Top management 'perceives' 'goals for client satisfaction' (3.4) as highly influential and uses it the most. Manufacturing, electricity, gas, and water industries rated the 'use' of 'goals for cost' (3.1) higher than the influence. The correlation is just about

the same among these goals, except for the 'goals for time', which has a weak correlation.

MULTI-PROJECT LEVEL

4. **Coordinated and structured links between projects** - no significant differences in variances for management levels or industries. Although this practice is not rated highly, it does have a strong correlation to portfolio success.
5. **Formal decision making on multi-project management** - no significant differences in variances for management levels or industries. Overall the correlation is strong, especially for the manufacturing industry.
6. **Formal decision making on resource distribution across entire portfolio** - there is significant differences in variances among management about the 'use' of this practice ($p=0.041<0.05$); top management and other management rate it much higher than the programme managers did. Overall the correlation is strong, especially with the manufacturing, transport, storage, and communications industries.
7. **Methods and PPM practices for comparing projects** - There are significant differences among management about two practices: (1) 'use of financial methods' (e.g. ECV, ROI, EV, NPV) (7.1) ($p=0.01$), the programme and project management rated this practice as low use, and (2) 'evaluation methods adapted to the requirements of the portfolio' (7.5) ($p=0.04$) was also rated as low 'use' according to project- and programme managers.

The 'use' and 'perception' of influence of multi-project level practices are low, compared to the other categories of practices. This leads to the question: The 'perception' and 'use' of multi-project level (portfolio level) practices is low compared to the other practices (refer to Table 45), yet they do have good correlations with the portfolio success (refer to Table 47). Why is there a gap in the 'use' and 'perception' of portfolio management practices?

LINK BETWEEN PROJECTS AND STRATEGY

8. **Alignment of projects** - There is a significant difference in the use of both practices, 'aligning each project to the strategy formulation' (8.1) (p=0.026), and 'reviewing and monitoring alignment of each project to the strategy' (8.2) (p=0.045), among management. Top management, portfolio management and other have used the alignment of projects more than project and programme management that work with the projects more directly and on a day-today basis. There is also a significant difference in the 'perception' of importance of 'reviewing and monitoring alignment of each project to the strategy' (8.2) (p=0.007), among industries. Transport, storage, communication, finance, and business services industries have rated this practice's 'use' much higher than the other industries, which could cause the variation in means.
9. **Alignment of portfolio** - There is a significant difference in the use of 'aligning entire portfolio to the strategy formulation' (9.1) (p=0.01), among management. Top and portfolio management use this practice more than project, programme, and other management. The industries have no significant differences in means.
10. **Alignment of resources** – There are no significant differences in means among the management or the industries for these practices.

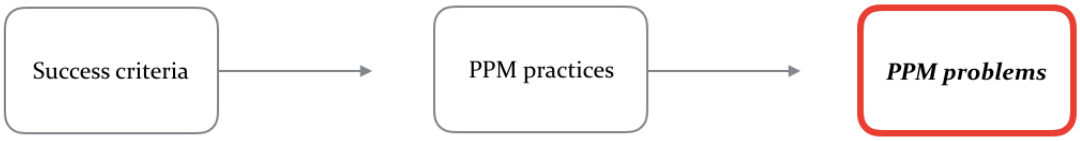
PROJECT INFORMATION

11. **Decision makers have all required information on projects** – There are no significant differences in means among the management or the industries for these practices. These practices were rated to have a high influence, but the actual use of them is much lower.
12. **Information quality** – There are no significant differences in means among the management or the industries for these practices. These practices were also rated to have a high influence on the portfolio management success, but the actual use of them is lower.

The trend under this category is unique compared to the other categories. The respondents 'perceive' the practices under this category as having a great influence, but they do not 'use' it often. This leads to the question: The 'perception' is that

practices of Project Information have a high influence on the success of Portfolio Management, but yet the practices are reported not to have been often in 'use'. Why is this and how could organizations improve this?

6.3 QUANTITATIVE – PPM PROBLEMS



6.3.1 QUESTION 4

a) What are the problems faced by industries?

As a result of different industries having different types of projects, each industry may be faced with faced with different problems .

Table 48 is a summary of the problems that were identified in the literature study and the intensity with which each industry faces those problems.

Table 48: The means of the problems faced by different industries, using a 1-4 Likert scale

	All industries N=342	Construction N=49	Finance and Business Services N=156	Transport. Storage and Communication N=33	Electricity, Gas, and Water N=24	Ma
1. Projects lack proper implementation	2.307	2.102	2.346	2.091	2.458	
2. Too many weak projects that are approved	2.333	2.061	2.429	2.273	2.417	
3. Inadequate methods and evaluation tools	2.339	2.224	2.449	2.121	2.417	
4. Link to strategy and strategic criteria not clearly defined	2.246	2.041	2.353	2.121	2.167	
5. Resources are not allocated effectively	2.623	2.449	2.673	2.394	2.583	
6. The flow of information is inadequate	2.355	2.184	2.391	2.333	2.375	
Intervals for ranks				1.75-1.999	2.0-2.249	
Colour ranking						

There are no significant differences among the industries concerning the problems they face. The heat map clearly shows how resources are a problem across all the industries. Figure 29 below shows the 95% confidence level between the different industries. The ways in which the graphs are numbered in the figure are the same as the numbering in

Table 48.

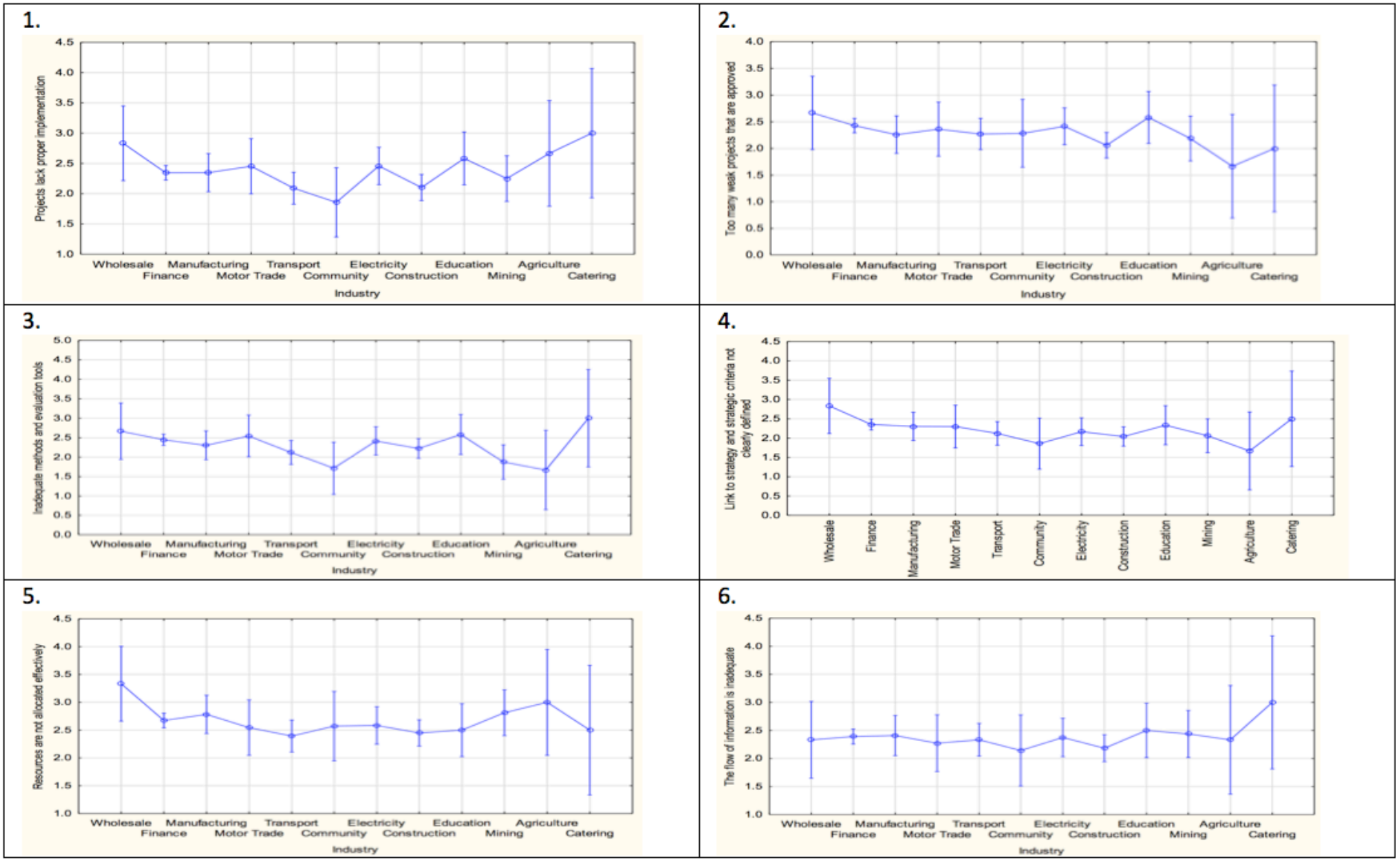


Figure 29: The means of the problems faced by all industries

Figure 29 clearly shows the distribution of answers across industry for the problems identified in this study. The five industries that had the most responses (shown in

Table 48) were also the industries that had the smallest variation in answers. For example, the 'Finance and Business Services' industry had the most responses and the shortest vertical bars; this indicates that there is a great confidence in the answers and that across the 'Finance and Business Services' industry, the same intensity of the identified problems are being faced. This same concept can be applied to the 'Construction', 'Transport, Storage and Communication', 'Electricity, Gas, and Water', and 'Manufacturing' industries, with the most confidence being in 'Construction' and the least in 'Electricity, Gas, and Water', and 'Manufacturing'.

The greatest problem that industries face is that 'resources are not allocated effectively'. Although this is a problem across all industries, Table 45 shows that the practices that deal with resource distribution (e.g. 3.5, 7.4, and 10) are not as often used as compared to the other practices. For example, practices such as 'right number of project methods (e.g. resource demand)', and 'alignment of resources', are not 'perceived' to have such a high influence and they are also not 'used' often. Making use of these practices do not necessarily improve the resource problem; the manufacturing industry face big resource allocation problems even though they use practices such as 'right number of project methods (e.g. resource demand)', and the practices under 'alignment of resources', just as much as the other industries. This leads us to the question: All the industries struggle with allocating resources effectively. Why is this a major problem and what can be done to solve it?

The second highest mean of the identified problems is that of 'the flow of information is inadequate'. However, the practices under 'project information' (see Table 45) are not often 'used' although they are 'perceived' to be influential. This could indicate a gap in the availability of information, for example management that do not keep information up to date throughout the projects and they do not reassess the project after the project has ended.

The perception and use of 'stage-gate or similar type of frameworks', were not rated as high as other practices, but it can solve the problem of 'too many weak projects that are approved'. The lack of 'use' of 'multi-project level' practices (Table 45) could be an explanation for the 'inadequate methods and evaluation tools' problem. The least worrying area is the 'link to strategy and strategic criteria not clearly defined'.

b) What are the problems faced by the different management levels?

As with Question 4a, this question tries to distinguish the difference in intensity of the problems problems faced by different management levels.

Table 49 below is a summary of the problems, comparing the different management levels.

Table 49: The means of problems faced by different management levels, using a 1-4 Likert scale.

	All N=342	Top Management N=77	Portfolio Management N=45	Programme Management N=62	Project Management N=110	
Projects lack proper implementation	2.307	2.234	2.244	2.419	2.336	
Too many weak projects that are approved	2.333	2.091	2.467	2.565	2.327	
Inadequate methods and evaluation tools	2.339	2.195	2.356	2.516	2.409	
Link to strategy and strategic criteria not clearly defined	2.246	1.987	2.386	2.371	2.273	
Resources are not allocated effectively	2.623	2.364	2.733	2.726	2.682	
The flow of information is inadequate	2.355	2.092	2.422	2.516	2.409	
Intervals for ranks				1.75-1.999	2.0-2.249	
Colour ranking						

Table 49 shows only one area that has a significant difference ($p<0.05$). This is the 'resources are not allocated effectively'. The reason for this is seen in Figure 30; the bootstrap method donates an 'a' for all the management levels except the top management, which is donated a 'b'.

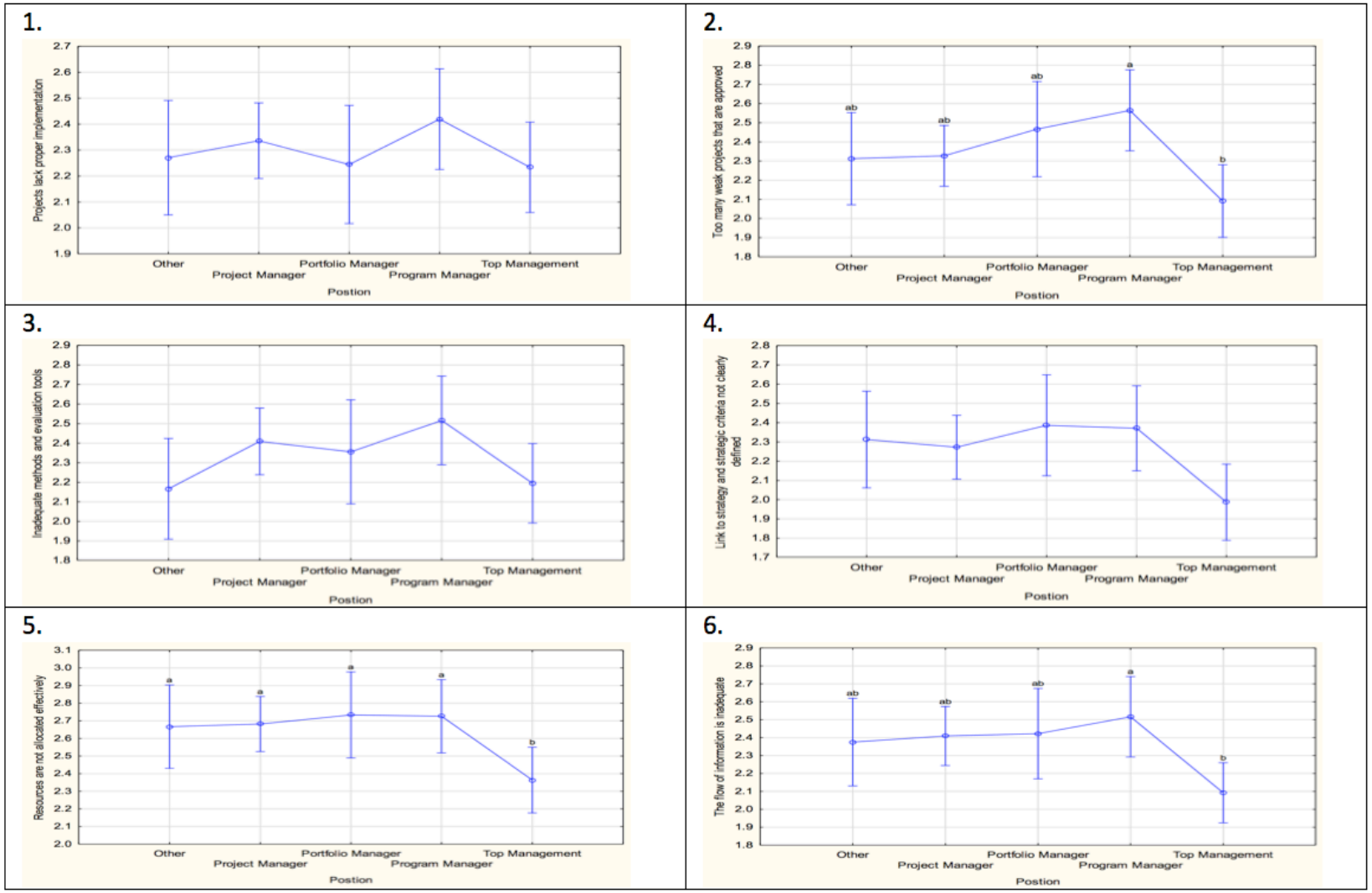


Figure 30: The means of problems faced by all management levels

The heat maps show that top management rated the problems identified in this study the lowest, whereas programme management rated the problems the highest. Programme management's biggest problem is 'resources are not allocated effectively', but they also use practices like 'right number of project methods' (e.g. resource demand) (see Table 46 7.4), although the least of all the management levels. Programme management has a highly rated mean with 'the flow of information is inadequate' problem, but they also use the practices under 'project information' (see Table 46), the least out of all the management levels. Programme management also has highly rated problems with 'inadequate methods and evaluation tools' and 'too many weak projects that are approved', but they use the practices under 'methods and PPM practices for comparing projects' (see Table 46, practice 7) the least of all the management levels.

It could be possible that the problems identified are more programme management problems and that top management has a different set of problems that are not mentioned in this study. This leads to the question: There seems to be a difference between top and middle management with the problems faced. What could be the explanation for this?

6.3.2 QUESTION 5

5) How do the problems faced by the organizations with portfolio managers differ from the problems faced without portfolio managers?

This question tries to identify the impact portfolio managers have by addressing the portfolio management problems in an organization. This was done by comparing the result of the 'problems' in categories of 'no portfolio manager' present and 'yes, there is a portfolio manager' present.

Table 50: Comparing the means of problems faced by organizations with and without portfolio managers, using a 1-4 Likert scale

	No portfolio manager (N=102)	**Yes**, there is a portfolio manager (N=236)	**Current effect (F)**	**p**
1. Projects lack proper implementation	2.441	2.25	4.386	0.037
2. Too many weak projects that are approved	2.451	2.275	2.994	0.085
3. Inadequate methods and evaluation tools	2.451	2.288	2.269	0.133
4. Link to strategy and strategic criteria not clearly defined	2.441	2.162	7.131	0.008
5. Resources are not allocated effectively	2.696	2.593	1.061	0.304
6. The flow of information is inadequate	2.515	2.28	5.536	0.019

Half of the problems had significant differences, in other words, three out of the six problems are greatly impacted (and improved) when a portfolio manager is present in an organization. To show these differences, Figure 31 below represents each problem using a 95% confidence graph, as well as the bootstrap method.

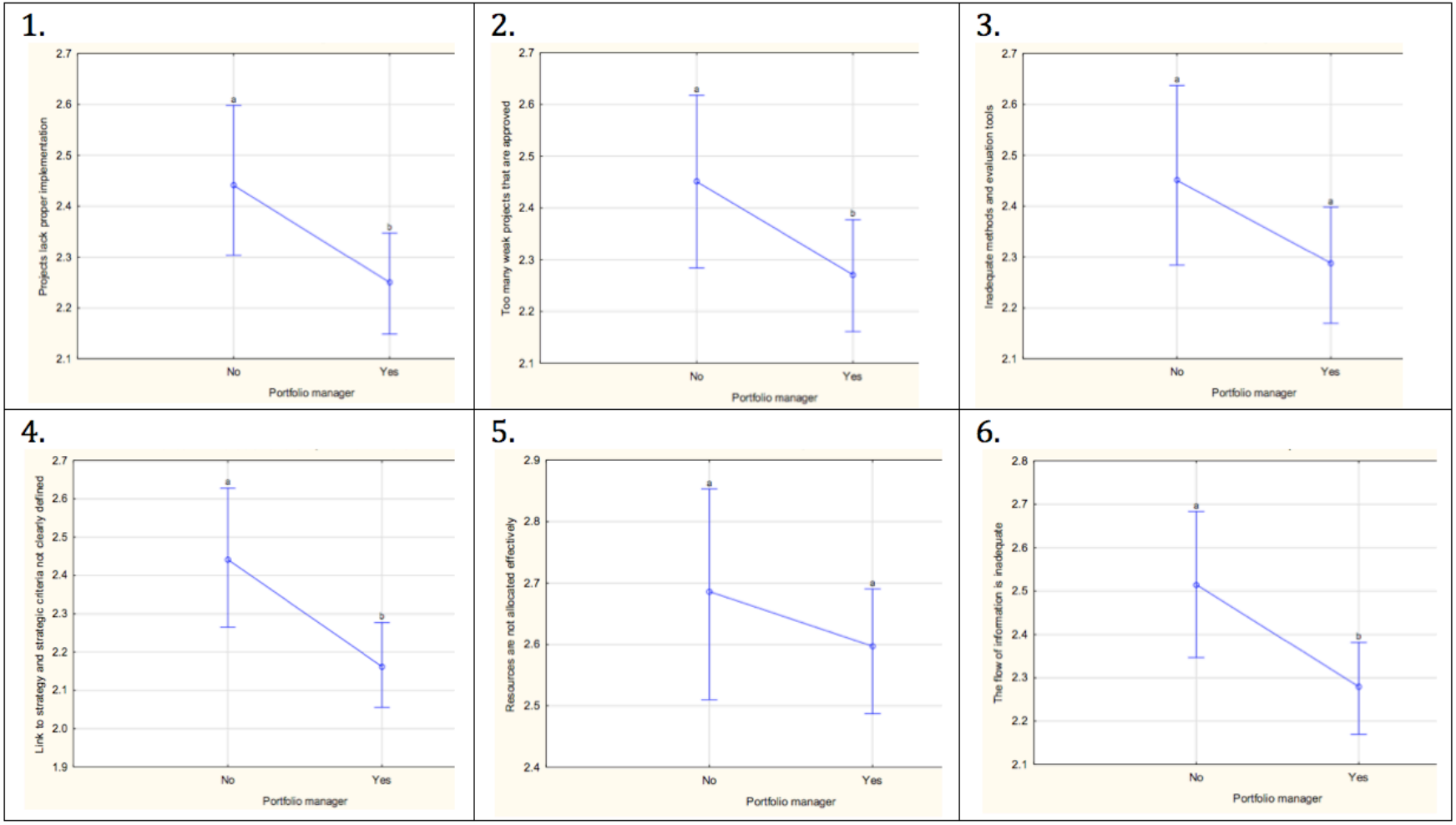


Figure 31: Comparing the means of problems faced by organizations with and without portfolio managers

Figure 31 clearly shows that all the portfolio managers do add value to the organization by addressing the problems of that organization. The Bootstrap method also shows the problems portfolio managers address the most. These problems are as follows in ranking order:

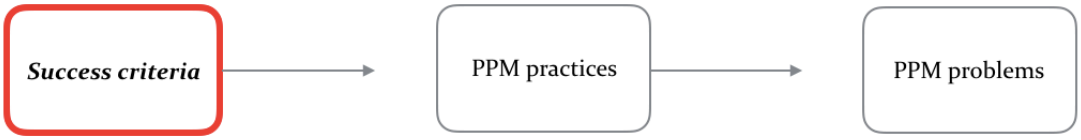
(1) Link to strategy and strategic criteria not clearly defined
(2) The flow of information is inadequate
(3) Projects lack proper implementation

After studying the three problems above, it is clear that portfolio managers clearly define the links to strategy and strategic criteria, improves information quality, and implements projects properly. This leads to the question: The results show that organizations with a portfolio manager in their organization rate the problems identified in this study lower than those organizations without a portfolio manager. What are the major benefits a portfolio manager can bring to an organization?

QUALITATIVE RESULTS

The quantitative findings presented some questions that needed the viewpoint of professionals. This section aims to gain better perspective of the main quantitative results, in order to draw the right conclusions. Out of the 342 survey participants, 4 participants were chosen for interviews on the findings of the survey. To analyse the interview results, this section used a thematic approach to analyse the data, as explained in section 5.4.5. Different themes were grouped together to produce the interview results.

6.4 QUALITATIVE - SUCCESS CRITERIA



6.4.1 QUESTION 1 & 2 RESULTS DISCUSSION

Overall comments on success criteria

ALL INDUSTRIES

In Question 1 (see section 6.1.1) the differences in rating for the success criteria was addressed. It was found that overall single-project success was the highest rated criteria. This could be because of the high level of project managers in the study, but this was also the criterion with the weakest correlation. Respondent 2 commented on this:

> *"People are comfortable with project management. They don't understand programme management very well. Projects don't necessarily work towards the same goals and of course if your programmes aren't in line then your portfolios certainly won't be. So the guys focus on what they know rather than the big picture. "*

Respondent 3 agrees with Respondent 2 and says there is a lack of understanding when it comes to portfolio management. Respondent 3 also said that 'it depends who (which

companies) you speak to' – some companies need portfolio management more than other companies.

ALL MANAGEMENT

Similar to Question 1, Question 2 addressed the different ratings between management levels in section **Error! Reference source not found.**. The strongest overall correlation to the portfolio success was the portfolio balance; the weakest correlation was average single-project success. In Respondent 1's interview she commented on this result as follows:

> *"It also shows me that people are running projects and not using proper selection criteria in selecting a project to see if it is in line with the portfolio and is in line with the strategic objectives."*

Respondent 4 said that companies do see projects as a value add, but they don't see the real benefits of the bottom line and they never retest it after the project has been executed:

"so you'll get a case where a project has been drawn up, the project has been procured, it has been executed and commissioned; and then two year down the line you have to ask the MD of the company 'was the project a success?', and often he wouldn't know how to answer that because he never gets vision."

Respondent 2 from the construction industry said that

> *"your portfolio should be linked to your strategy and if you don't have a balanced corporate strategy, you don't have a portfolio and people are doing projects on a 'who shouts that loudest' basis".*

6.5 QUALITATIVE – PRACTICES

6.5.1 QUESTION 3 RESULTS DISCUSSION

Question 3 looked at the perception of practices' influence and the level of use of practice differ according to different industries, as well as different management levels.

COMMENTS ON ALL PRACTICES

In the interview Respondent 1 commented on all the best practices and why the implementations of best practices are not effective:

> *"Well, what you will find... again ... a prerequisite is for Executives ... to support and drive the whole methodology or best practice. They need to drive that and get it embedded in the organization. They also need to make sure that every business unit, every functional area, whether it be marketing, HR, procurement, legal, IT needs to be in aligned and the policies processes and procedures needs to ... needs to be aligned to best practice and that's not happening. This is where the quality is lacking within an organization: firstly, executives don't have the knowledge, secondly they don't know what the best practices are, thirdly, they employ or place people in project management positions that have no idea."*

Respondent 2 and Respondent 4, both agree that there is a lack of knowledge when it comes to portfolio management and the best practices. Respondent 2 said that:

> *"Currently I'm not seeing them (executives) being educated enough and realizing the benefits of portfolio management."*

Respondent 3 agrees with the lack of education from the executive level, but also added that

> *"the presence of portfolio management at strategic level is not strong enough...companies have PMOs, but we do not report in at the higher echelon, we report through a buffer managers. In other words, the company then doesn't see project portfolio management at the CEO strategic level, they see it through a buffer manager who doesn't necessarily understand it. I think therein lies the gap; organizations don't empower the organization through portfolio thinking".*

SINGLE-PROJECT LEVEL

Overall single-project-level practices were 'perceived' to be the most influential as well as the most 'used'. This category did not necessarily have the strongest correlation but Respondent 2 explained that the reason for these high ratings under this category is, because of a lack of knowledge of the practices in the other categories:

> *"People are comfortable with project management, they don't understand programme management very well."*

MULTI-PROJECT LEVEL

The 'use' and 'perception' of multi-project level practices are low compared to the other categories of practices. This was pointed out in the interviews and Respondent 1's comment was the following:

> *"What you'll find is that projects need to be selected based on proper selection criteria. Executives don't know what that selection criteria are."*

The perception and use of portfolio level practices could be low because the selection criteria are ineffective.

Respondent 2 said that there is a lack of portfolio management 'use' of practices because

> *"the guys don't really understand portfolio management; they certainly don't understand programme management … I would say South Africa is five years behind other countries such as the UK with our portfolio management".*

Respondent 4 says that although people do not understand the practices

> *"I tend not to believe that the people don't believe in the benefits of portfolio management because from my encounters people are definitely moving towards portfolio management. Maybe not now but they have already made the transition … in some industries South Africa in on par, but in other industries we are about five years behind".*

Respondent 3 added to this by saying that the 'perception' and 'use' is different to different people:

> *"it depends who you ask … the gap is simply a lack of knowledge and organizational maturity, if the perception and use of these practices are low … The current political turmoil and the need for rapid transformation will likely impact the rate of change. Inversely so however, that very dynamic also introduces new energy which may even improve the desire to modernize our practices to world standards. For the time being, I think I'll stick to my posit that we lag some ten years behind the developed world. "*

LINK BETWEEN PROJECTS AND STRATEGY

Respondent 4 said that the

> *"South African industry is evolving, where they are taking portfolio management a bit more seriously now … There is more of a tendency for us to manage our strategy using a portfolio of projects. There is definitely a transition with managing individual projects to managing portfolios."*

Respondent 3 thinks that the projects are managed at the execution level and not the strategic level:

> *"Do I manage my project at a strategic level? Or do I let it go to tactical level of the portfolio management? Or do I let it happen at the execution level? I suspect much of it happens at the execution and tactical level where the programme management happens. I think the portfolio thinking just doesn't happen at executive level, where it should happen."*

PROJECT INFORMATION

Respondent 2 gave a reason why the 'perception' of project information is high, but the 'use' is low:

> *"By the time a project finishes, trust me, the guys are looking towards other projects and not towards correlating all that information, all the mistakes, all the mitigating actions and how successful they were or not … the guys don't necessarily capture the information throughout the project, but that information is actually key to ensuring the same mistakes aren't recurrently made."*

Respondent 4 agrees with Respondent 2:

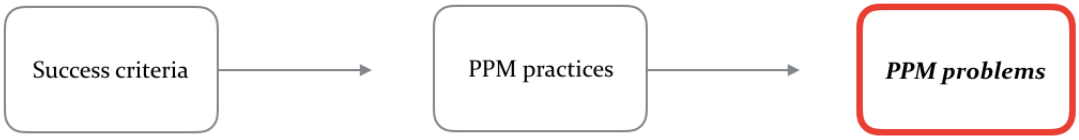
> *"People very often see projects as 'yes we have to do it because we are tapping the need now', but they never go back and reassess what was the big benefit of that project. It gets lost in translation and no one ever follows up and conclusively looks if the project achieved what it set out to achieve."*

Respondent 3 states that there is a big problem when it comes to project reporting:

> *"The problem is with the reporting mechanisms itself … percentage completion does not correctly relate to time remaining and effort remaining. For example, if I have a project, the intensity is not linear, and there may be some S-curve; it dependents on the complexity of the task. What is my complexity? In other words, percentage complete cannot be a good reflection … the organization does not know how to use project reporting. "*

It is difficult to quantify the project and pass the information on to higher management levels.

6.6 QUALITATIVE – PPM PROBLEMS



6.6.1 QUESTION 4 RESULTS DISCUSSION

Question 4 addressed the problems faced by different levels of management and the different industries.

INDUSTRIES

The most obvious observation is, that 'resources are not allocated effectively', is the biggest problem. Respondent 4 said that the companies face resources problems due to

> *"a combination of things like budgets which is a big factor. You are always trimming your resources because you don't have the money, and there is also the issue of obtaining the right resources. We often don't have the right skills."*

Respondent 2 confirmed this and said that resource allocation is a major problem and one of the causes are that the skills needed for the projects are not *'matched to the skillset'* of the people. Respondent 1, who trains people says that:

> *"at the moment what you'll find is that resources are over allocated. I'm talking about people resources, they are over allocated, and people don't actually know what they are doing and when they are doing it".*

Respondent 3 said:

> *"if organizations don't do multi resource planning and scheduling, then they are reactive and not proactive in their behaviour."*

Although this is a problem across all industries, the use of practices in

Table 45 below shows the difference in 'perception' of importance and 'use' of practices using the means in ANOVA analysis. Using the heat mapping techniques, it is clear which practices are 'perceived' higher than others and which practices are 'used' more than others.

Table 45 show that there is a gap in practice and better or more methods such as the 'right number of project methods (e.g. resource demand)' and 'alignment of resources' (

Table 45 below shows the difference in 'perception' of importance and 'use' of practices using the means in ANOVA analysis. Using the heat mapping techniques, it is clear which practices are 'perceived' higher than others and which practices are 'used' more than others.

Table 45 7.4 and 11) can be used.

MANAGEMENT

Respondent 1's thought on why she thinks the problems that were mentioned are rated differently between the top and middle management:

> *"Middle management will be the ones to prevent strategic implementation because their jobs are usually at risk … with regards to executives, and I've seen this, I've been in corporate boardrooms, I've seen it so often, is that top management haven't got a cooking clue what is going on and they put in all the wrong controls, that stifle innovation, that stifle progression. It is a sad state of*

affairs where also middle managers will want to initiate projects for their personal gain and that is not linked to strategy. Again, that shows me that there is no proper programme or selection criteria."

Respondent 4's perspective is a bit different to Respondent 1's:

"It is a symptom of top managers not wanting to admit problems and they want to downplay their problems … middle managers would try to make them (the problems) bigger because it tends to shift the problem upwards … I would think that the results that you are getting, is just a symptom of managerial behaviour and not a reflection of what is actually the true problem … It is a symptom which you will find in all industries, top management will never make the problem bigger than what middle management will do. Middle management is closer to it and it is their work, whereas the top guy will look at everything globally and looks at the effect of that particular problem on the rest of the business, so it definitely get diluted."

Respondent 3's view is also different from both, Respondent 4 and Respondent 1's:

"Top and middle management don't see the same problem, not from the same frame of reference … they (top management) don't know what it (problem) is, huge maturity failure within the business."

6.6.2 QUESTION 5 RESULTS

Question 5 looked at how the problems faced by the organizations with portfolio managers differ from the problems faced by organizations without portfolio managers. The results clearly showed that organizations without portfolio managers seem to face more challenges. The interviewees were asked to comment on these questions' results and what they thought the benefits of having a portfolio manager could have on an organization. The results were the following:

Respondent 1 said that portfolio managers could only make an impact when they are at a top management and authority level because:

"if the portfolio manager is at the right level and they actually have the right criteria they are using to look at organizational risk, to look at how they are managing their resources, to look at how the program and business as usual is going to change and meet their strategic objectives. Then portfolio managers of course will be successful because it has that executive drive and support. And when a policy or process is hindering the strategic objectives, then they will be able to change it. So that is why companies who have proper portfolio managers will be more successful than those who don't have".

***Respondent 2** said:*

"Portfolio managers bring the organizational strategy into delivery. Having those people in place with that big picture view, the holistic view, is critically important because how are you going to identify if projects are slightly off track … They are especially important when it come to two big programs, programs are already delivering multiple projects … where two programmes could clash, portfolio management becomes very important."

Respondent 4 said:

"The biggest benefit that a portfolio manager can bring is that it (organization) is aligned with the business strategy. He know what the business mandate is and he has aligned himself, the project he is managing, and the project managers he is managing."

6.7 SUMMARY AND RECOMMENDATIONS

This chapter analysed the collected quantitative data from the surveys and identified uncertainties that were addressed in the interviews in the qualitative sections. This section, built on the quantitative and qualitative results, make the relevant recommendations for PPM practitioners or those who are considering applying PPM practices to their organization. Table 51 is a summary of the main data findings, comments from the professionals, and future recommendations.

Table 51: Recommendations to the uncertainties identified in the data findings.

Main data findings	Main points from interviews with professionals	Recommendations
Industries rated portfolio balance as one of the lower success criteria, yet overall it has the strongest correlation.	• Projects are selected and run using the wrong selection criteria. • Without proper success criteria, the projects lack vision. • The portfolio relies strongly on a balanced corporate strategy.	• The top- and portfolio managers need to be educated on the different success criteria as well as complementary tools and frameworks that help achieve those success criteria. • More attention needs to be given to portfolio balance.
Although single-project success is ranked the highest, the correlation to portfolio management success is the weakest.	• Project management is easy to understand and the success is easy to measure. • There is a lack of knowledge and understanding of programme- and portfolio management.	• Attention needs to be given to the criteria the projects are selected on. • All management types should be educated on the basics of portfolio management.
The 'perception' is that practices of Project Information have high influence on the success of portfolio management, yet the practices are reported not to have been often in 'use'.	• The necessary information is not captured during or post-project. • Information capturing is key to ensure mistakes aren't repeated. • There are inadequate reporting mechanisms. • The organization does not know how to use proper project reporting.	• Information must continuously be capture (pre-, during, and post-project). • An analysis of the successes and failures must be re-evaluated after the project or before starting a new project. • Organizations should invest in finding an appropriate reporting tool that all levels of management can understand and use. • The type of information such as measurements must be pre-specified and agreed upon (this might change for the different project characteristics)
The 'perception' and 'use' of multi-project level (portfolio level) practices is low compared to the other	• Executives are not educated enough on the practices of PPM. • The presence of portfolio managers at strategic level is not strong enough.	• Educate executive on the practices and importance of PPM. • Portfolio managers should be placed in influential positions such as the strategic or corporate level of business. • All the other management levels should cooperate with the

practices, yet they do have good correlations with the portfolio success.	• People are comfortable with project management and don't understand programme management. • People are moving towards portfolio management. • The lack of multi-project use is a lack of knowledge and organizational maturity. • South Africa lags 5-10 years behind the developed world.	portfolio managers to implement the PPM practices and support the process. • Feedback on the best practices needs to be updated in order to improve portfolio management within the company. • Educate all the management levels on the basic benefits of using PPM.
Industries' biggest struggle is to allocate resources effectively.	• The budget management can cause resources to be trimmed. • There is a lack of the right skills. • Resources are over allocated. • Some organizations don't do multi-resource planning and scheduling.	• To mention a few, practices such as the following can be used to improve resource management: (1) goals for resources, (2) right number of project methods (e.g. resource demand), (3) aligning resource allocations with strategy, (4) reviewing and monitoring the alignment of resources to strategy. • It is recommended that South African companies improve their Project Information practices (refer to framework, section 4.2) in order for resource management to improve. • Before projects are chosen, a resource evaluation, planning, and scheduling must be done to see what the project's future demands will be.
There seems to be a difference between top and middle management with the problems faced.	• Middle management prevent strategic implementation and initiate projects for their personal gain and that is not linked to strategy. • Top management put in all the wrong controls because of a lack of knowledge. • Top management do not want to admit their problems. • Top management have a global perspective and compares the severity of the problem to the other	• Only top- and portfolio managers must choose the projects for the portfolio. • Top management needs to be educated on which controls are important. • Continuous communication needs to be made between top- and middle management. • Project Information practices (refer to framework, section 4.2) needs to be improved.

	problems in the organization. • Middle managers works closer to the project and try to make the problems bigger to shift problem up the hierarchy. • If top management do not know what the problem is then there is a maturity failure in the organization.	• Programme- and project managers need to be educated on basic portfolio management practices in order to understand and put their problems into perspective • Top management also needs to be educated on the basics of project management in order for them to understand the programme- and project managers' problems, the impact the problems will have, and possibly help brainstorm for solutions.
The results show that organizations with a portfolio manager in their organization rate the problems identified in this study lower than those organizations without a portfolio manager.	• Portfolio managers bring the organizational strategy into delivery. • The portfolio managers need to be at the right level of the organization to make an impact. • The right criteria are still needed to reduce the problems. • Portfolio managers look at risk, managing resources and ultimately reach the strategic objectives. • Important to have a holistic view and keep projects on track.	• Small and less mature companies do not necessarily have portfolio managers, but it is still advised to use the PPM practices. • Portfolio managers can help deliver the strategy, but the rest of the organization must support their efforts to implement PPM processes.

The biggest trend in the recommendations is to address the knowledge gap of PPM practices. This is a critical part to help the portfolio managers implement the strategy. The second big trend is the project information must be updated and communicated to management on all levels.

CHAPTER 7 - CONCLUSIONS AND RECOMMENDATIONS

The previous six chapters were strategically planned to be able to draw the right conclusions, give meaningful recommendations, and contribute to the body of knowledge. The previous chapter consisted of quantitative and qualitative results that were gathered through a survey and through interviews. The findings to this research were divided into three sections: (1) success criteria, (2) practices, and (3) problems. This chapter intends to address the following: theoretical overview, research methodology, findings, limitations, and make the necessary recommendations for further research; this is shown in Figure 7.

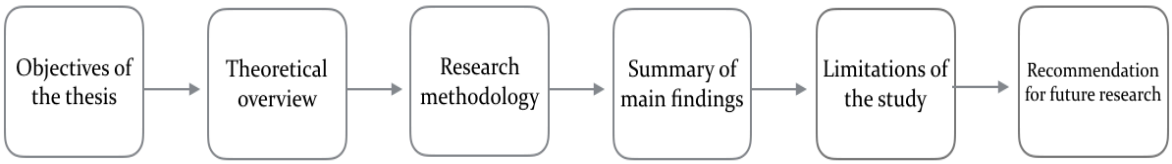
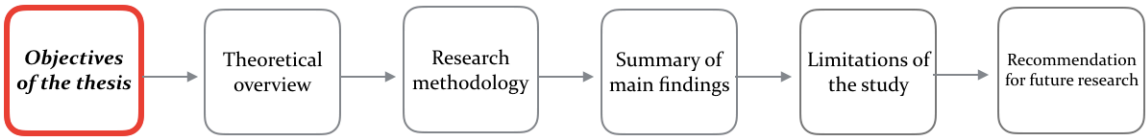


Figure 32: Steps followed in the conclusion.

7.1 OBJECTIVES OF THE THESIS



The main research objective of this thesis, as stated in Chapter 1, was to '*empirically investigate the link between the implementation of various project portfolio management practices and the perceived success of project portfolios within a South African context in order to derive at recommendations for project portfolio management at South African companies.*'

In order to achieve this aim of this thesis, the eight objectives were created. The objectives and the chapters they were addressed in are summarized in Table 52 below:

Table 52: Summary of the objectives and the chapters addressed in.

#	Objectives	Chapters objectives were addressed
1	Critically review definitions of strategy and how strategy and PPM are interrelated.	3
2	Critically review and analyse existing theory, tools, and frameworks of PPM.	3
3	Critically review and analyse the empirical literature on PPM.	3 & 4
4	Critically review and analyse literature for the definition of PPM success criteria.	3
5	Construct a conceptual framework of the best practices of PPM, based on literature.	4
6	Perform an empirical study evaluating the implementation of PPM practices, the link between the implementation of PPM practices and perceived PPM success and the perceived link between PPM practices and PPM success.	5 & 6
7	Review the results from the empirical study and investigate arising uncertainties through further qualitative analysis.	5 & 6
8	Synthesise the results obtained throughout the study to derive recommendations for PPM practice in South Africa	6

Table 52 shows the objectives and the chapters addressed, Figure 33 below shows where in the thesis structure each objective was addressed. Objectives 1-4 were achieved in Chapter 3 through a thorough review on relevant literature, the process for this review was one

proposed by Jabareen (2009). Objective 5 was achieved in Chapter 4 by constructing a conceptual framework on the PPM factors. Objective 6 and 7 was achieved in Chapter 5 and 6 by performing a mixed method study using qualitative and quantitative means of collecting data. Objective 8 was also achieved in Chapter 6; the results from the data collection contributed to the conclusion and recommendations made.

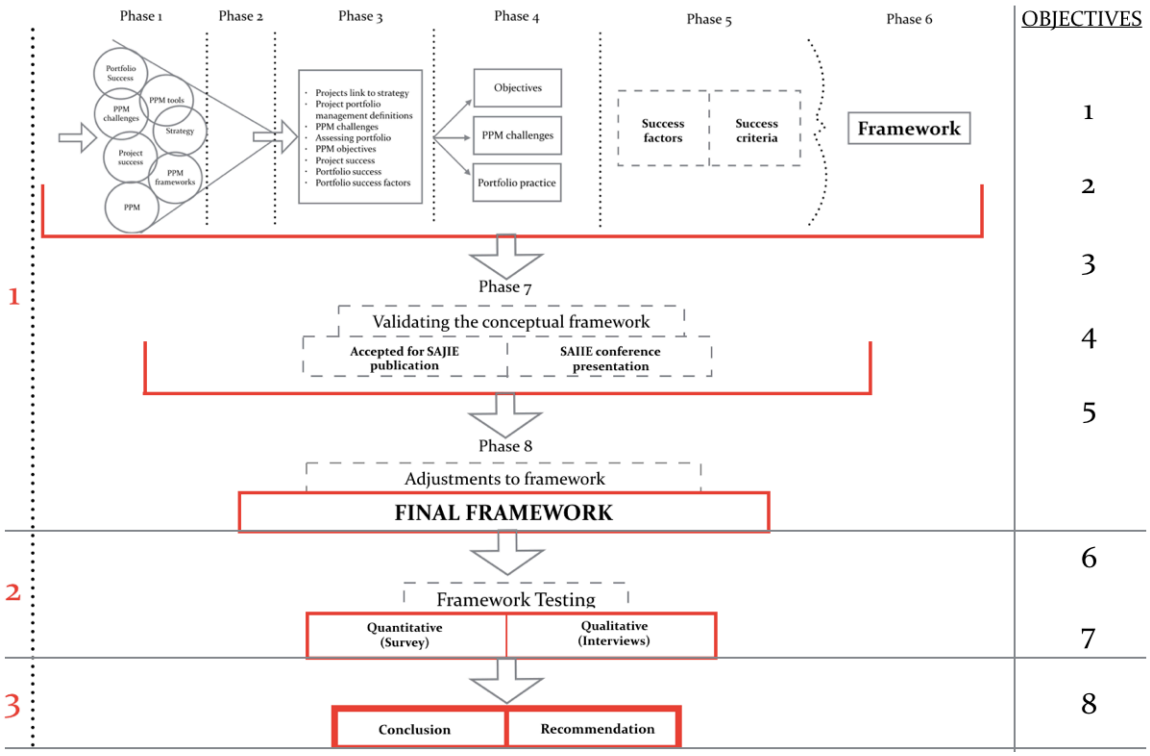
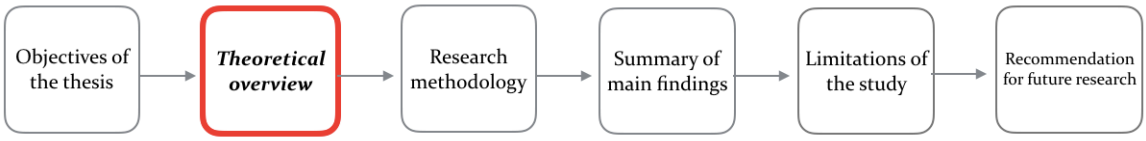


Figure 33: Section of the thesis each objective was achieved

7.2 THEORETICAL OVERVIEW

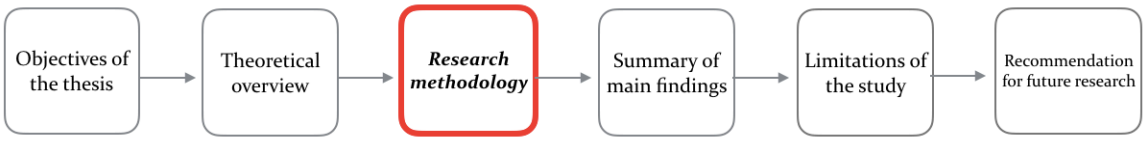


A literature review was conducted to investigate project portfolio management as a topic. It identified how PPM is linked to strategy, the factors that influence PPM, the problems that organizations are faced with, and how success is measured within PPM.

The review was done on existing literature, but despite the growth and importance, PPM is still a field that is being developed. PPM is defined in different ways, but for the purpose of this study, it was defined as the simultaneous management of a whole collection of projects as one big entity. Literature can be very general in approach, but when applying the PPM practices to an organization, there are many complexities and unique aspects for each organization to consider.

The literature review was divided into three sections namely: (1) strategy, (2) project portfolio management, and (3) success. Objectives 1, 2, 3, and 4 were addressed in the literature review as shown in Table 52 above.

7.3 RESEARCH METHODOLOGY



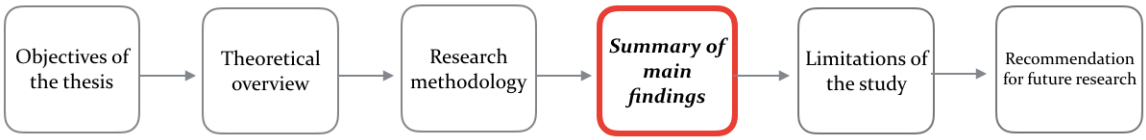
The research objective was investigated by applying the methodology outlined in Chapters 2 and 4, which produced the results in Chapter 5. Chapter 2 explained the steps followed to create the conceptual framework. This was followed by Chapter 4, which tested the conceptual framework. A mixed-method approach was used in this thesis to empirically test the conceptual framework. This was done in two stages.

The first stage was performed using a survey method. This is explained in section 5.3. The survey was carefully planned and pilot tested before it was sent out for final data collection. The survey was sent to 1942 participants with a focus on strategic, portfolio, programme, and project managers; the responses obtained were 342. The data was analysed using different formula, the most common being the mean, as well as Spearman's correlation coefficient.

The second stage used semi-structured interviews to understand and investigate the results found in the first stage. Of the 166 participants who agreed to be interviewed in the

first stage, there were 3 who were chosen. The development of the interviews is found in section 5.4

7.4 SUMMARY OF MAIN FINDINGS



The main findings are summarized in three sections: (1) success criteria, and (2) PPM practices, (3) problems. The findings fulfilled objectives 6, 7, and 8 as shown in Table 52 above.

7.4.1 SUCCESS CRITERIA

The success criteria among industries and among management did not have any significant differences among the means, in other words, the way in which different management or different industries rank the success criteria, is just about the same. Portfolio balance was ranked among the lowest of the success criteria, yet it had the strongest correlation to portfolio success. The opposite is true for single-project success; it was ranked the highest, but had the weakest correlation to portfolio success. Naturally the practices that were often 'used' were focused on single-project success and those that weren't often 'used' were found to be balancing methods. A justification for this could be that organizations have more success criteria than the four identified in this study.

Portfolio selection criteria are one of the most vital decisions that will affect portfolio success. If the projects for the portfolio are not chosen based on the appropriate selection criteria, there is a greater probability that the portfolio will be unsuccessful (refer to section 6.4.1). Therefore appropriate and strategically aligned projects need to be selected for the portfolio to be successful. The misconception regarding the importance of choosing the success criteria should be addressed by making practitioners aware of this fallacy.

7.4.2 PPM PRACTICES

The trends of the practices namely 'use' and 'perception' of importance, were very similar amongst the different industries and management levels; there were few significant differences with the best practices identified. The successes of the best practices are not just dependent on the tool or technique used, but also on the support and dedication from management, to become successful. Portfolio managers need to be in an influential role within the company to drive and support the entire methodology or the best practice of PPM. The practices that are chosen for the organization's objectives have a higher chance of being successful if supported and implemented by the top management. Top and portfolio management needs to ensure that every business unit and functional area is aligned with the policies, processes, and procedure that implement the organization's strategy and ultimately achieve the organization's objectives.

Respondent 2, 3, and 5 said that South Africa lag about 5-10 years behind other developed countries in the practices of portfolio management. As noted in the interview with Respondent 1, more attention needs to be given to the knowledge of executives to inform them on the best practices of project and portfolio management. Table 53 below ranks the overall answers according to the highest means.

Table 53: Ranking the 'perception' and 'use' of practices

Rank	Ranking of perceived practices	Ranking of perceived utilisation of practices
1	Decision makers have accurate information	Goals for costs
2	Decision makers have up to date information	Goals for time
3	Internal information	Goals for client satisfaction
4	Goals for client satisfaction	Continuous formal decision making throughout project execution
5	Continuous formal decision making throughout project execution	Goals for quality
6	Goals for time	Formal pre-project planning and decision making tools selected for each individual project
7	Goals for costs	Aligning each project to the strategy formulation
8	Goals for quality	Internal information
9	External information	Use of project process models

10	Aligning each project to the strategy formulation	Goals for resources
11	Formal pre-project planning and decision making tools selected for each individual project	Use of financial methods (e.g. ECV, ROI, EV, NPV)
12	Formal decision making on resource distribution across entire portfolio	Decision makers have up to date information
13	Formal decision making on multi-project management	Formal decision making on multi-project management
14	Aligning entire portfolio to the strategy formulation	Decision makers have accurate information
15	Reviewing and monitoring alignment of each project to the strategy	Formal decision making on resource distribution across entire portfolio
16	Goals for resources	Aligning entire portfolio to the strategy formulation
17	Resource allocations aligned with strategy	Formal decision making on resource distribution across entire portfolio
18	Reviewing and monitoring alignment of entire portfolio to the strategy	Reviewing and monitoring alignment of each project to the strategy
19	Coordinated and structured links between projects	Reviewing and monitoring alignment of entire portfolio to the strategy
20	Use of financial methods (e.g. ECV, ROI, EV, NPV)	External information
21	Reviewing and monitoring the alignment of resources to strategy	Resource allocations aligned with strategy
22	Use of project process models	Coordinated and structured links between projects
23	Stage-gate or similar type of frameworks used	Reviewing and monitoring the alignment of resources to strategy
24	Strategic methods (e.g. strategic bucket model, strategic check, product road map)	Right number of project methods (e.g. resource demand)
25	Evaluation methods adapted to the requirements of the portfolio	Evaluation methods adapted to the requirements of the portfolio
26	Right number of project methods (e.g. resource demand)	Strategic methods (e.g. strategic bucket model, strategic check, product road map)
27	Balancing methods (e.g. risk-reward bubble diagram, traditional charts such as pie charts, mapping method)	Balancing methods (e.g. risk-reward bubble diagram, traditional charts such as pie charts, mapping method)

The table above ranks each practice to the results obtained from the surveys. However, Figure 34 groups the individual practices together into the four main categories and used the averages to summarizing the 'perception' of importance and the frequency of 'use' into a graph.

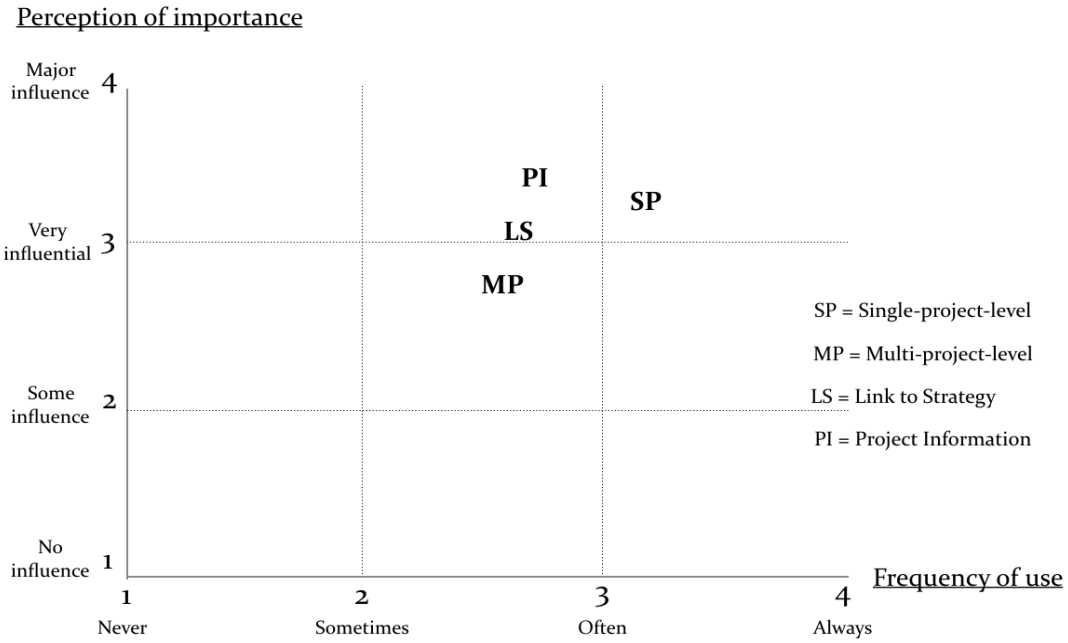


Figure 34: Graph summarizing the 'perception' of importance of practice vs. the frequency of 'use'

Single-project-level: Practices were often 'used' as well as 'perceived' to have great influence on the portfolio success (see Figure 34), yet the correlation was not as high as the other factor categories. The practices under this category is 'perceived' and 'used' often because it is easy to understand and implement into the organization. There are a high number of project managers that completed the survey, but looking at the results, there are close to no differences in the 'perception' of practice importance and 'use' of the single-project-level practices. This confirms that it is not just project managers who focus on single-project-level practices, but also the higher management levels. Higher management levels are supposed to be focusing more on multi project level practices (section 3.5). This could prove that there is a lack of knowledge and confidence to use multi-project-level practices.

Multi-project-level: Practices were not 'perceived' to be very influential, and as a result, are not often 'used'. However, the correlation between these practices and portfolio success was overall higher than the correlations of the single-project practices. The low ratings are likely, because people are not educated enough about portfolio management and related best practices as more people are educated about project management. For

example, although portfolio balance is one of the success factors and has the strongest correlation to portfolio success, the practice such as 'balancing methods' was ranked as the least 'used' and 'perceived' and the smallest influence on portfolio success (see Table 53). This proves that there is a gap in knowledge about which success criteria to use, as well as the tools or techniques to achieve those successes.

Link to strategy: The main most important objective of PPM is to link the projects with the company's strategy – all the interviewees agree on this. One could say that aligning the projects and the portfolio with the strategy, is the foundation that portfolio management is built on. However, the practices 'use' and 'perception' of importance is not as high as single-project level practices (see Figure 34). Aligning and reviewing the resource allocations with the strategy, is also not as frequently 'used' or 'perceived' as such a high importance; this could possibly explain the problem of 'resources not effectively allocated'.

There were some significant differences amongst the industries and management levels, rating the 'use' and 'perception' of importance of the practices that fall under this category. Some of the practices also had a higher 'perception' of importance than the actual 'use' of practice. The correlations of the practices were overall the highest compared to the other categories.

Project Information: The 'perceived' importance in these practices are much higher than the 'use' of practices, (see Figure 34). The top three overall practices that are 'perceived' to have an influence on the portfolio success fall in this category (see Table 53), but they are not as highly ranked for the 'use' of practice.

Organization to keep up to date information on their portfolio and projects; as shown by the results, this is not done in industry. As mentioned by Respondent 2, when projects are done, people start to focus on the next project and they do not give enough attention to how the information of the project correlates. It is important to keep record, learn from the mistakes and to see how successful the actions taken for the project were. With lack of information capturing, the same mistakes are mostly likely to be made.

7.4.3 PROBLEMS

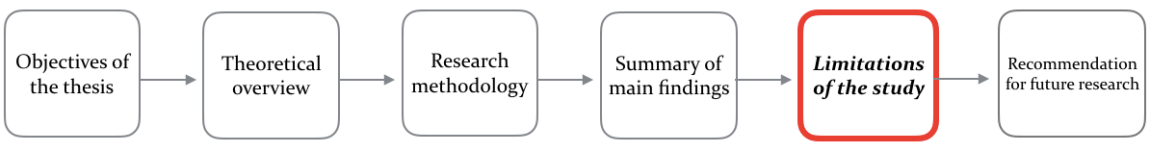
There is a major problem with resource distribution across all the industries and the management types. Some companies lack focus when it comes to resource distribution, and this could lead to problems such as employees not knowing what they need to do, and when they need to do it. This lack of focus could hinder many processes and ultimately delay or force a project to run out of resources. Resource distribution problems could be a result of the lack of 'use' of resource distribution practices. The practices that benefit resource distribution were not 'used' as often, compared to other practices.

The second major problem is that of 'the flow of information is inadequate'. Although this is a highly ranked problem, the 'use' of the practices that addresses this problem is low, although it is 'perceived' to be a great influence on the portfolio success (see Table 53). This could indicate a gap in the availability of information. Management needs accurate and up to date information for this problem to be addressed.

The 'use' and 'perception' of importance of 'multi-project level' practices (Table 45) is low compared to the other practices, but this could be an explanation for the 'inadequate methods and evaluation tools' problem. There is a lack of knowledge on the benefits of portfolio management practices, and therefore it is not often 'used' and the problems are not addressed effectively.

The results from the survey show that top management rated the problems identified in this study, lower than middle management. This could be a result of managerial behaviour; middle managers are directly faced with the problems and thus perceive the problems higher, whereas top management takes a holistic view by comparing and assessing the effect of problems on the entire organization.

7.5 LIMITATIONS OF THE STUDY



This study used the methodology proposed by Jabareen (2009) to construct the conceptual framework. This study only used literature and no practical experience. If the literature used in this study is not an accurate description of the practical field then that could limit this study. There are many articles, books, and other sources that include the topics of project-, programme-, and portfolio management; this study only used the sources that were seen to be relevant to the study and scope.

The participants for the survey were from a variety of different industries; this study only identified eleven industries, which limits the results, conclusions, and recommendations to only a few industries and not all the industries in South Africa. The responses from the eleven industries were not evenly distributed; only five industries had sufficient response rates to represent their industry. The results in this study does not apply to all PPM users and should be adapted to each individual company's needs.

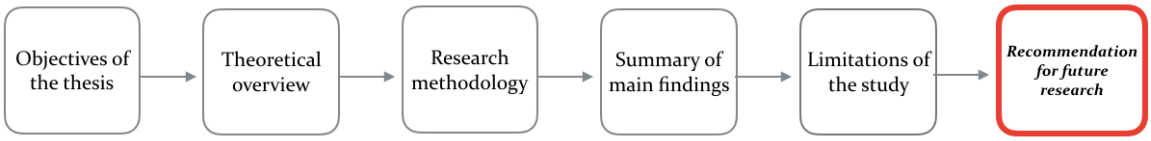
The management levels identified are also limiting, depending on the size and maturity of the organization; e.g. in a small and less mature company the top management might take on the responsibilities and perform the practices of a portfolio and project manager. In some companies the roles and responsibilities are not clearly defined, especially between portfolio-, programme-, and project managers.

The candidates interviewed were to represent the different viewpoints from the four industries with the highest response rates. Although the candidates had vast amounts of experience, this does not necessarily mean that the candidates' experiences apply to their entire industry. Some of the interviews were also limited by not being face-to-face, but rather through a cell phone; this makes limits the interviewer's ability to read the candidates' body language. The candidates had only South African experience and their answers do not necessarily apply to other countries.

While correlation research can suggest that there is a relationship between two variables, it cannot prove that one variable causes a change in the other variable. There are many different success criteria, problems, and PPM practices that were not included in this

study; the perceived portfolio management success could be a result of the other practices that were not mentioned in this study. Results of the practices used, and challenges faced in PPM will differ from organization to organization, as well as from project to project. The main reason for this is the maturity and complexity difference between projects and organizations. The results and conclusions drawn from this study do not apply to all industries or all countries; it must still be adapted to each organization's specific needs.

7.6 RECOMMENDATIONS FOR FUTURE RESEARCH



This study contributes to project portfolio management research, especially in South Africa. The findings of this study underline the importance of organizations driving project portfolio management to achieve organizational strategic success. The strategy must be customized to the organization's characteristics; this is also true for PPM, the practices and managerial approach must be unique to the organization's characteristics and complexities. Managers need to improve their knowledge on PPM, as well as the supporting driving forces that PPM practices requires.

The PPM practices also help implement the organizational strategy through the projects. With regards to the organizational strategy, the objectives must be communicated to all levels of management; this can be done through the use of PPM practices. One of the main benefits of PPM (if maintained well) is that it provides the right information needed to make strategic decisions. The results in this study show that South African organizations still need to improve on the recording and communication of information. It is recommended that organizations improve their information by constantly updating information, pre-project, during the project, and post-project. The practices identified in the framework under the category 'Project Information' can be used as a guideline or check list; further project information mechanisms need to be researched and developed to best suit the organization's characteristics and needs; this mechanism must be easy to

use and understood by all management levels. The type of information such as measurements must also be researched and pre-specified to allow managers to identify where the project is at (in terms of the schedule or plan) and what is needed for the project (this might change for the different project characteristics).

This study showed the knowledge gaps in the South African industries; according to the interviewees South Africa is 5-10 years behind other developed countries. It is recommended that more education and training opportunities needs to be provided to the employees. This gap can be filled in two general ways: 1) externally, sending employees for courses and educational training, and 2) internally, by recording, assessing, and analysing past projects in order to learn from the successes and failures. Organizations can also address this gap by funding research and conducting case studies customized to their characteristics and environment.

The foundation of the portfolio is built on the criteria selected; it is strongly recommended that management spend appropriate time and effort selecting the right success criteria for the organization. The PPM practices must also be selected by considering the unique complexities and characteristics of the organization. To address the problems identified in this study, it is advised for management to make use of some of the appropriate practices identified in this study's framework.

The framework constructed in this study only analysed a few PPM practices, for further studies, there are still many other practices that need to be analysed. This study also did not go into depth with the practices identified, further studies could focus on a more in-depth level on some of these practices and the best ways to execute the processes. As mentioned in the limitations (see 7.5) this study covered eleven industries (with a focus on only five); further studies could take the following approaches: case studies, focus on one specific industry, or/and focus on one management level. This study used a literature approach to construct the framework; another way could be to construct a framework from practical experience.

This study used a correlation approach with does not necessarily prove the relationship between two variables; a combination of different variables could be the cause for the effect. It is recommended that further studies be conducted on the different variable inputs and possible outcomes.

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APPENDICES

APPENDIX A

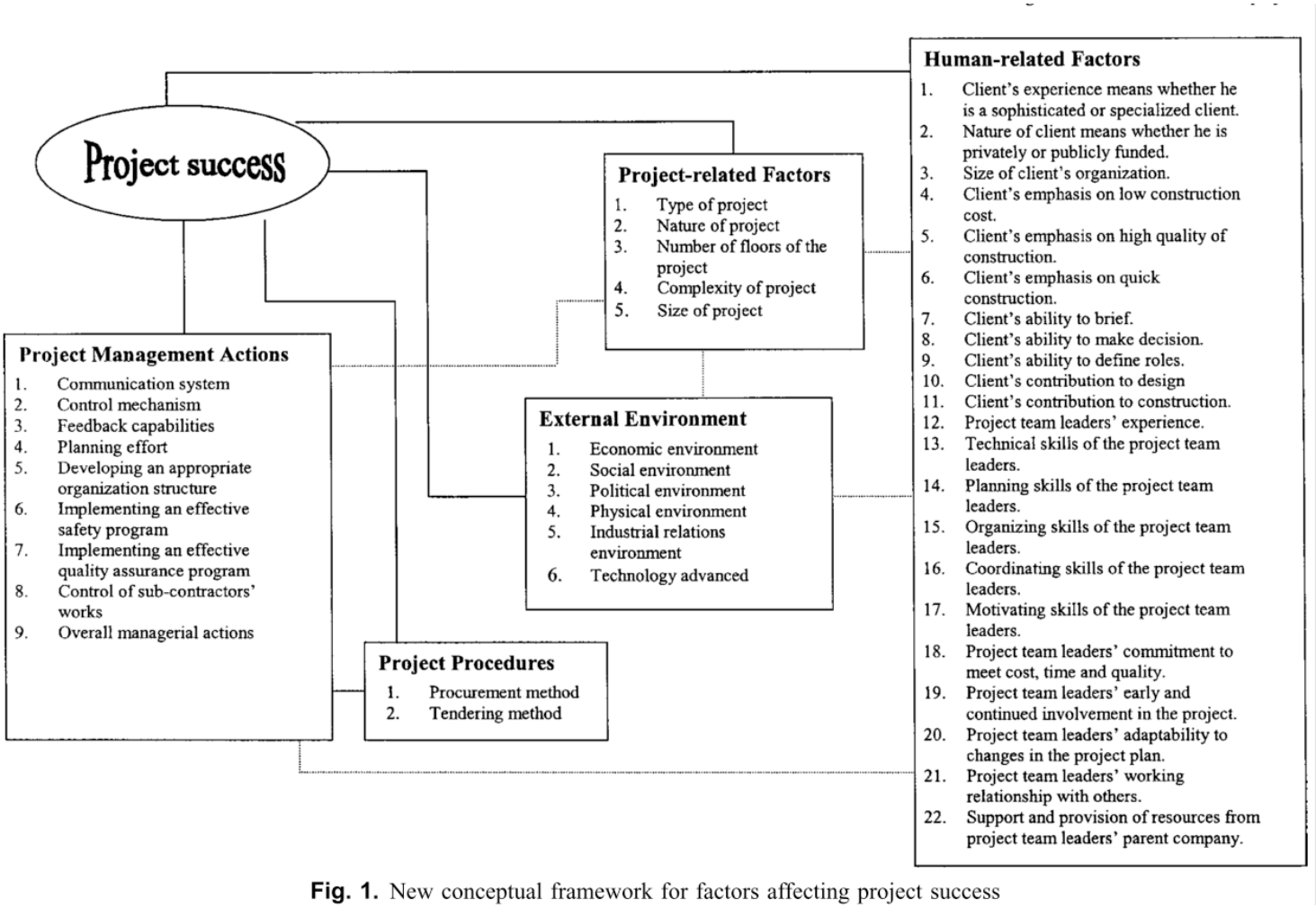


Fig. 1. New conceptual framework for factors affecting project success

Figure 35: Factors affecting project success (Chan, Scott, and Chan, 2004)

APPENDIX B

1. SURVEY QUESTIONS

Project Portfolio Management

Thank you for participating in this study.

The objectives of this study are to determine the factors that influence the success of **project portfolio management (PPM)**. We are interested in your perception of how factors influence the success of a portfolio.

The survey should take about 10 minutes to complete. Please be assured that the information will solely be used for the research purposes and at all times be treated as confidential and anonymous; no organizations will be identified.

* 1 Under which industry is your organization classified (according to the Standard Industrial Classification)?

- Agriculture
- Catering, Accommodation and other Trade
- Community, Social and Personal Services
- Construction
- Education
- Electricity, Gas and Water
- Finance and Business Services
- Manufacturing
- Mining and Quarrying
- Retail and Motor Trade and Repair Service

- ○ Transport, Storage and communications
- ○ Wholesale Trade, Commercial Agents and Allied Services

* 2 How many full-time employees work for your organization?

- ○ 0 - 49
- ○ 50 - 99
- ○ 100 - 199
- ○ 200+

* 3 Does your organization have an official project portfolio manager?

- ○ Yes
- ○ No
- ○ I don't know

* 4 What is your position within the organization? (Please refer to the picture in the email for clarification)

- ○ Top Management (strategic management)
- ○ Portfolio Manager
- ○ Program Manager
- ○ Project Manager
- ○ Other...

* 5 How, would you say, does your organization rank the following project portfolio management success criteria?

	Little to no importance	Some importance	Above average importance	Very important
The portfolio is aligned with the organizational strategy - the extent to which the portfolio reflects the company's strategy.	○	○	○	○
The portfolio is balanced - a portfolio that balances different criteria (selected by the organization) such as risk vs. achieving the growth and profit objectives.	○	○	○	○
The average single project success - individual projects (within the portfolio) fulfilling their own set of success criteria such as cost, time, quality, client satisfaction etc.	○	○	○	○
The use of synergies - making use of synergies between projects such as technical- or makert-synergies.	○	○	○	○

*6 How successful do you perceive your organization's project portfolio management?

Unsuccessful	Slightly successful	Mostly Successful	Very Successful
○	○	○	○

*7 **Single-project level** - this refers to the characteristics, activities, and decisions made on a single-project level.

	In your opinion, how often is this practice used in your organization?	In your opinion, how influential is this practice on PPM success?
Project process models		
Formal pre-project planning and decision making tools selected for each individual projects	✓ I don't know 1 = never 2 = sometimes 3 = often 4 = always	
Continuous formal decision making throughout project execution		
Goal for cost		
Goals for time		
Goals for quality		
Goals for client satisfaction		
Goals for resources		

*8 **Multi-project level** - this refers to the characteristics, activities, and decisions made on a portfolio level (i.e. a combination of single-projects).

	In your opinion, how often is this practice used in your organization?	In your opinion, how influential is this practice on the PPM success?
Coordinated and structured linkage between projects		✓ 1 = no influence 2 = some influence 3 = very influencial 4 = major influence
Formal decision making on multi-project management		
Formal decision making on resource distribution across entire portfolio		
Financial methods (e.g. ECV, ROI, EV, NPV)		
Balancing methods (e.g. risk-reward bubble diagram, traditional charts such as pie charts, mapping method)		
Strategic methods (e.g. Strategic bucket model, strategic check, product road map)		
Right number of project methods (e.g. resource demand)		

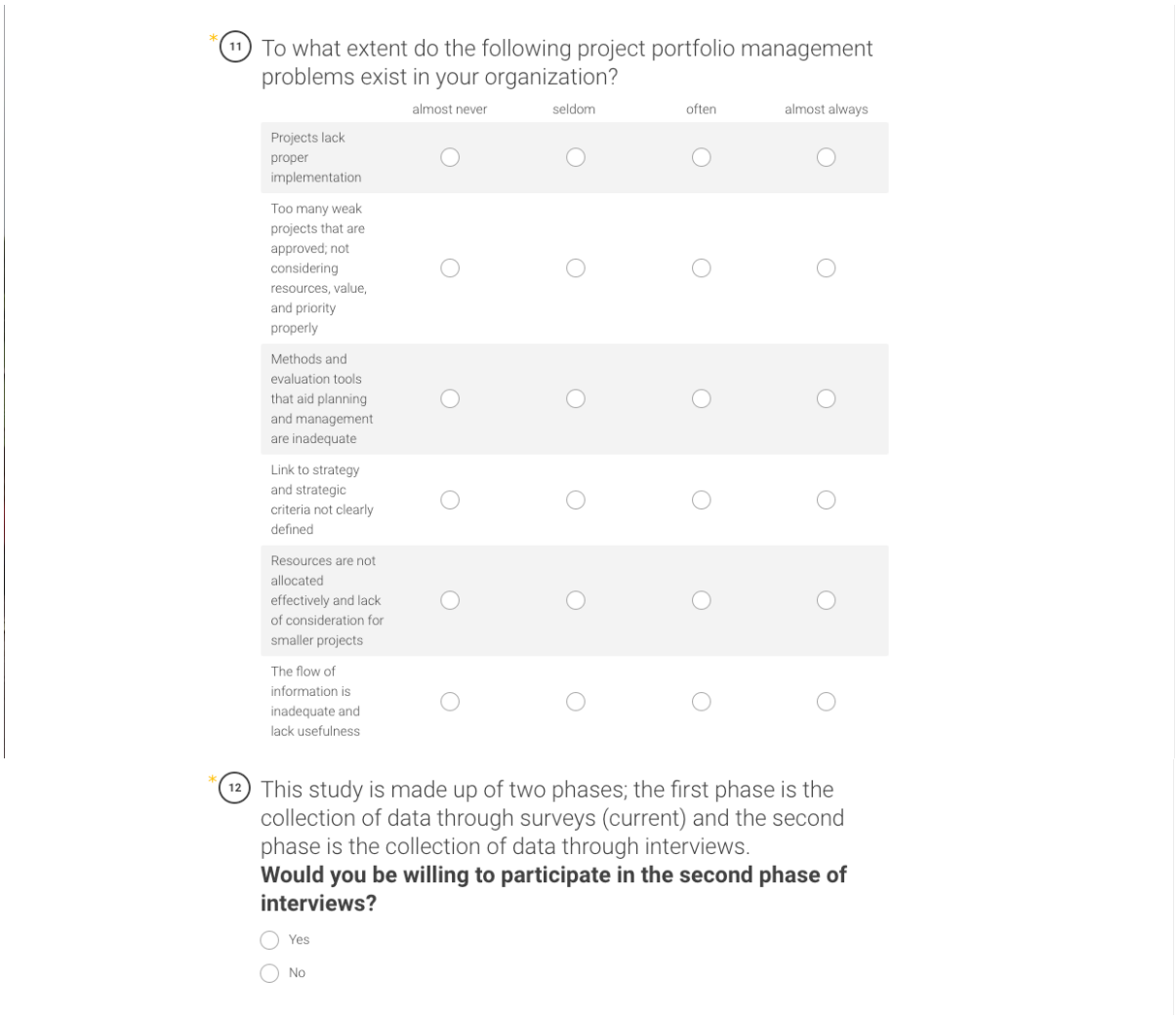
Evaluation methods adapted to the requirements of the portfolio		
Stage-gate or similar type of frameworks used		

* 9 **Linkage to strategy** - this refers to the ability to link the projects and the organizational strategy.

	In your opinion, how often is this practice used in your organization?	In your opinion, how influential is this practice on PPM success?
Aligning each project to the strategy formulation		
Reviewing and monitoring alignment of each project to the strategy		
Aligning entire portfolio to the strategy formulation		
Reviewing and monitoring alignment of entire portfolio to the strategy		
Resource allocations aligned with strategy		
Reviewing and monitoring the alignment of resources to strategy		

* 10 **Project information** - this refers to the availability and quality of information that the portfolio managers need to make effective decisions.

	In your opinion, how often is this practice used in your organization?	In your opinion, how influential is this practice on PPM success?
Decision makers have all required internal information on projects		
Decision makers have all required external information on projects		
Decision makers have accurate information		
Decision makers have up to date information		



* 11 To what extent do the following project portfolio management problems exist in your organization?

	almost never	seldom	often	almost always
Projects lack proper implementation	○	○	○	○
Too many weak projects that are approved; not considering resources, value, and priority properly	○	○	○	○
Methods and evaluation tools that aid planning and management are inadequate	○	○	○	○
Link to strategy and strategic criteria not clearly defined	○	○	○	○
Resources are not allocated effectively and lack of consideration for smaller projects	○	○	○	○
The flow of information is inadequate and lack usefulness	○	○	○	○

* 12 This study is made up of two phases; the first phase is the collection of data through surveys (current) and the second phase is the collection of data through interviews.
Would you be willing to participate in the second phase of interviews?

○ Yes
○ No

Figure 36: Screenshots of the survey sent to participants

2. COVER LETTER FOR THE SURVEY

Dear participant

The Engineering for Financial Services research group in the Department of Industrial Engineering, Stellenbosch University, is conducting a survey on the factors and practices that influence the success of **project portfolio management.** This study specifically targets practices in **strategic management, project portfolio management, program management**, and **project management.**

The survey should take about 10 minutes to complete. Please be assured that the information will solely be used for the research purposes and it will be treated as confidential and anonymous at all times.

Please follow the link below to take the survey:
https://www.surveymonkey.com/r/LV6CVJB

If you are interested in the findings of this study, please fill in your email address at the end of the survey and an executive summary will be shared with you upon completion of the study. If you know anyone who fits the criteria of participating in this survey, please be so kind as to forward this email to them. We appreciate your involvement in this study.
For any enquiry, please contact us:

Lead researcher: chiaraoosthuizen@gmail.com

Kind regards

The Engineering for Financial Services team

APPENDIX C

1. COVER LETTER FOR INTERVIEWS

Dear Respondent,

Once again thank you for taking part in our survey. We sincerely appreciate the interest you have taken in this study.

The results from the surveys have been finalized and we have selected a few candidates to be interviewed.
Would you please take part in our final data collection stage, which comprise of the interviews?

Kind regards

Chiara Oosthuizen

2. ATTACHED DOCUMENT WITH THE INTERVIEW QUESTIONS

INTERVIEW QUESTIONS

The results are divided into three sections: (1) success criteria, (2) practices, and (3) problems. Each question will state which table/figure it is referring to.

Success Criteria

Question 1

Industries rated portfolio balance as one of the lower success criteria, yet overall it has the strongest correlation. Why do you think this is? (Refer to table 1 and 2)

Question 2

Although single project success is ranked the highest, the correlation to portfolio management success is the weakest. What underlying dynamics may cause this? (Refer to table 1 and 2)

Table 54: Ranking success criteria according to different industries

	All industries N= 337	Construction N=49	Finance and Business Services N=156	Transport, Storage and Communications N=33	Electricity, Gas, and Water N=24	Manufacturing N=23	F	p	Kruskal-Wallis
The portfolio is aligned with the organizational strategy	2.74	2.612	2.782	2.696	2.625	2.696	1.11	0.35	0.43
The portfolio is balanced	2.623	2.592	2.679	2.576	2.417	2.565	0.88	0.53	0.66
The average single project success	2.787	2.816	2.782	2.879	2.625	2.696	0.79	0.62	0.42
The use of synergies	2.553	2.612	2.603	2.576	2.208	2.478	1.2	0.29	0.41
Ranking sections					2.0-2.19	2.2-2.39	2.4-2.59	2.6-2.79	2.8-3
Ranking colour									

Table 55: Correlation factor (rs) between the success criteria and perceived portfolio success according to different industries

	All industries N=337	Construction N=49	Finance and Business Services N=156	Transport. Storage and Communication N=33	Electricity, Gas, and Water N=24	Manufacturing N=23
The portfolio is aligned with the organizational strategy	0.462	0.416	0.469	0.475	0.41	0.523
The portfolio is balanced	0.528	0.515	0.463	0.669	0.683	0.562
The average single project success	0.321	0.090	0.28	0.096	0.615	0.322
The use of synergies	0.463	0.231	0.452	0.425	0.818	0.411
Intervals for ranks		0.0-0.199	0.2-0.399	0.4-0.599	0.6-0.799	0.8-1
Colour ranking						

Practices

Question 3

The 'perception' is that practices of Project Information have a high influence on the success of Portfolio Management, yet the practices are reported not to have been often in 'use'. Why is this and how could organizations improve this? (Refer to table 3)

Table 56: The use (U) and perception (P) of influence on portfolio success, using a 1-4 Likert scale, according to different industries

		All industries		Construction		Finance and Business Services		Transport. Storage and Communication		Electricity, Gas, and Water		Manufacturing		p	
		P	U	P	U	P	U	P	U	P	U	P	U	P	U
Project information															
11	Decision makers have all required information on projects														
11.1	Internal information	3.345	2.968	3.327	3.102	3.359	2.936	3.333	3.125	3.292	2.917	3.304	2.870	0.986	0.656
11.2	External information	3.202	2.624	3.184	2.714	3.192	2.568	3.273	2.774	3.333	2.708	3.130	2.609	0.761	0.568
12	Information quality														
12.1	Decision makers have accurate information	3.399	2.794	3.429	2.898	3.340	2.800	3.455	2.906	3.417	2.583	3.304	2.652	0.915	0.289
12.2	Decision makers have up to date information	3.368	2.822	3.367	2.816	3.346	2.824	3.424	2.938	3.458	2.750	3.273	2.636	0.727	0.819
Intervals for ranks		2.0 - 2.249		2.25-2.499		2.5 - 2.749		2.75 - 2.999		3 - 3.249		3.25 - 3.499		3.5 - 3.749	
Colour ranking															
Colour ranking															

Question 4

The organizations with portfolio managers face fewer problems, according to the means taken from the six problem areas (refer to table 8). The 'perception' and 'use' of multi-project level (portfolio level) practices are low compared to the other practices (refer to table 4), yet they do have good correlations with the portfolio success (refer to table 5). Why, would you say, is there such a gap in the 'use' and 'perception' of portfolio management practices?

Table 57: The use (U) and perception (P) of influence on portfolio success, using a 1-4 Likert scale, according to different industries

		All industries		Construction		Finance and Business Services		Transport. Storage and Communication		Electricity, Gas, and Water		Manufacturing		p	
		P	U	P	U	P	U	P	U	P	U	P	U	P	U
Single-project level															
1	Use of project process models	2.901	2.922	2.694	2.717	2.878	2.947	3.152	3.25	2.917	2.958	2.783	2.913	0.19	0.155
2	Decision-making practices														
2.1	Formal pre-project planning and decision making tools selected for each individual project	3.143	3.047	3.143	3.102	3.096	2.962	3.273	3.156	3.167	3.083	3.174	3.087	0.54	0.434
2.2	Continuous formal decision making throughout project execution	3.251	3.222	3.204	3.265	3.205	3.160	3.394	3.273	3.292	3.375	3.304	2.957	0.17	0.483
3	Clearly defined goals and success measures per single project														
3.1	Goals for costs	3.24	3.376	3.327	3.469	3.192	3.297	3.212	3.333	3.333	3.500	3.348	3.652	0.502	0.402
3.2	Goals for time	3.246	3.339	3.265	3.388	3.205	3.282	3.424	3.364	3.208	3.458	3.435	3.435	0.94	0.607
3.3	Goals for quality	3.216	3.173	3.163	3.347	3.186	3.058	3.424	3.242	3.208	3.125	3.304	3.391	0.319	0.263
3.4	Goals for client satisfaction	3.33	3.273	3.163	3.354	3.359	3.250	3.576	3.424	3.208	2.958	3.391	3.261	0.322	0.572
3.5	Goals for resources	3.012	2.853	2.878	2.938	3.019	2.890	3.212	2.909	3.000	2.792	2.956	2.565	0.291	0.707
Multi-project level															
4	Coordinated and structured linkage between projects	2.968	2.598	2.75	2.563	3.013	2.596	3.000	2.697	3.083	2.500	2.826	2.652	0.77	0.887
5	Formal decision making on multi-project management	3.05	2.82	2.792	2.745	3.097	2.826	3.063	2.906	3.250	2.917	2.913	2.652	0.4	0.579
6	Formal decision making on resource distribution across entire portfolio	3.112	2.763	3.042	2.958	3.103	2.845	3.344	2.750	3.167	2.391	3.087	2.522	0.599	0.19
7	Methods and PPM practices for comparing projects														
7.1	Use of financial methods (e.g. ECV, ROI, EV, NPV)	2.964	2.844	2.848	2.787	2.878	2.686	3.161	2.935	2.958	2.87	3.182	3.174	0.805	0.102
7.2	Balancing methods (e.g. risk-reward bubble diagram, traditional charts such as pie charts, mapping method)	2.499	2.306	2.413	2.318	2.417	2.24	2.656	2.438	2.696	2.409	2.739	2.304	0.563	0.32

7.3	Strategic methods (e.g. strategic bucket model, strategic check, product road map)	2.731	2.426	2.489	2.111	2.735	2.457	2.844	2.719	2.917	2.391	2.783	2.522	0.297	0.092
7.4	Right number of project methods (e.g. resource demand)	2.701	2.48	2.646	2.413	2.722	2.544	2.813	2.581	2.708	2.455	2.545	2.273	0.296	0.492
7.5	Evaluation methods adapted to the requirements of the portfolio	2.71	2.462	2.711	2.6	2.686	2.443	2.848	2.516	2.875	2.5	2.522	2.381	0.904	0.324
7.6	Stage-gate or similar type of frameworks used	2.793	2.728	2.723	2.622	2.701	2.705	2.788	2.625	2.782	2.857	2.826	3	0.12	0.001
Linkage between projects and strategy															
8	Alignment of projects														
8.1	Aligning each project to the strategy formulation	3.176	3.021	2.878	2.938	3.213	3.045	3.364	3.061	2.958	2.833	3.087	2.957	0.258	0.744
8.2	Reviewing and monitoring alignment of each project to the strategy	3.018	2.756	2.816	2.551	3.103	2.813	3.212	2.970	2.917	2.417	2.652	2.478	0.007	0.053
9	Alignment of portfolio														
9.1	Aligning entire portfolio to the strategy formulation	3.035	2.757	2.750	2.596	3.096	2.794	3.152	2.969	2.875	2.565	2.909	2.682	0.069	0.365
9.2	Reviewing and monitoring alignment of entire portfolio to the strategy	2.979	2.653	2.833	2.489	2.981	2.662	3.242	2.938	2.792	2.391	2.870	2.500	0.151	0.187
10	Alignment of resources														
101	Resource allocations aligned with strategy	3.001	2.607	2.816	2.644	3.038	2.601	3.063	2.656	3.000	2.542	3.136	2.565	0.601	0.738
10.2	Reviewing and monitoring the alignment of resources to strategy	2.906	2.515	2.755	2.468	2.917	2.556	3.091	2.727	2.708	2.261	3.043	2.364	0.632	0.326
Project information															
11	Decision makers have all required information on projects														
11.1	Internal information	3.345	2.968	3.327	3.102	3.359	2.936	3.333	3.125	3.292	2.917	3.304	2.870	0.986	0.656
11.2	External information	3.202	2.624	3.184	2.714	3.192	2.568	3.273	2.774	3.333	2.708	3.130	2.609	0.761	0.568
12	Information quality														
12.1	Decision makers have accurate information	3.399	2.794	3.429	2.898	3.340	2.800	3.455	2.906	3.417	2.583	3.304	2.652	0.915	0.289
12.2	Decision makers have up to date information	3.368	2.822	3.367	2.816	3.346	2.824	3.424	2.938	3.458	2.750	3.273	2.636	0.727	0.819

Intervals for ranks	2.0 - 2.249	2.25-2.499	2.5 - 2.749	2.75 - 2.999	3 - 3.249	3.25 - 3.499	3.5 - 3.749
Colour ranking for 'use'							
Colour ranking for' 'perceived'							

Table 58: The Spearman's correlation coefficients (rs) between the use of practices and the perceived portfolio success

		All industries N=342	Construction N=49	Finance and Business Services N=156	Transport. Storage and Communication N=33	Electricity, Gas, and Water N=24	Manufacturing
Single-project level							
1	Use of project process models	0.5078	0.422	0.583	0.619	0.23	0.67
2	Decision-making practices						
2.1	Formal pre-project planning and decision making tools selected for each individual project	0.547	0.611	0.547	0.656	0.642	0.608
2.2	Continuous formal decision making throughout project execution	0.431	0.393	0.433	0.357	0.353	0.673
3	Clearly defined goals and success measures per single project						
3.1	Goals for costs	0.317	0.282	0.283	0.561	0.275	0.419
3.2	Goals for time	0.248	0.279	0.245	0.274	0.264	0.165
3.3	Goals for quality	0.486	0.173	0.501	0.592	0.362	0.573
3.4	Goals for client satisfaction	0.439	0.25	0.4	0.532	0.742	0.361
3.5	Goals for resources	0.452	0.326	0.511	0.553	0.581	0.198
Multi-project level							
4	Coordinated and structured linkage between projects	0.514	0.193	0.508	0.706	0.567	0.608
5	Formal decision making on multi-project management	0.489	0.325	0.485	0.504	0.56	0.688
6	Formal decision making on resource distribution across entire portfolio	0.498	0.32	0.519	0.627	0.415	0.614
7	Methods and PPM practices for comparing projects						
7.1	Use of financial methods (e.g. ECV, ROI, EV, NPV)	0.496	0.314	0.496	0.498	0.531	0.577
7.2	Balancing methods (e.g. risk-reward bubble diagram, traditional charts such as pie charts, mapping method)	0.513	0.507	0.442	0.576	0.663	0.634
7.3	Strategic methods (e.g. strategic bucket model, strategic check, product road map)	0.515	0.362	0.429	0.685	0.569	0.644
7.4	Right number of project methods (e.g. resource demand)	0.503	0.528	0.474	0.561	0.447	0.666
7.5	Evaluation methods adapted to the requirements of the portfolio	0.577	0.374	0.573	0.656	0.608	0.658
7.6	Stage-gate or similar type of frameworks used	0.414	0.392	0.444	0.48	0.246	0.764
Linkage between projects and strategy							
8	Alignment of projects						
8.1	Aligning each project to the strategy formulation	0.489	0.427	0.457	0.594	0.456	0.406
8.2	Reviewing and monitoring alignment of each project to the strategy	0.555	0.398	0.546	0.729	0.355	0.608
9	Alignment of portfolio						
9.1	Aligning entire portfolio to the strategy formulation	0.546	0.583	0.481	0.691	0.415	0.718

9.2	Reviewing and monitoring alignment of entire portfolio to the strategy	0.566	0.641	0.492	0.724	0.483	0.716
10	Alignment of resources						
10.1	Resource allocations aligned with strategy	0.529	0.347	0.567	0.605	0.519	0.494
10.2	Reviewing and monitoring the alignment of resources to strategy	0.506	0.418	0.515	0.555	0.379	0.569
Project information							
11	Decision makers have all required information on projects						
11.1	Internal information	0.4	0.259	0.398	0.582	0.462	0.317
11.2	External information	0.418	0.196	0.412	0.394	0.603	0.322
12	Information quality						
12.1	Decision makers have accurate information	0.424	0.161	0.338	0.598	0.633	0.528
12.2	Decision makers have up to date information	0.441	0.342	0.411	0.558	0.6	0.379
Interval for ranks				0 - 0.2499	0.25 - 0.499	0.5 - 0.749	0.75 - 1
Colour rank							

Problems

Question 5

All the industries struggle with allocating resources effectively. Why is this a major problem and what can be done to solve it? (Refer to table 6)

Table 59: The means of the problems faced by different industries, using a 1-4 Likert scale

	All N=342	Construction N=49	Finance and Business Services N=156	Transport. Storage and Communication N=33	Electricity, Gas, and Water N=24	Manufacturing N=23	**Current effect (F)**	**P**
Projects lack proper implementation	2.307	2.102	2.346	2.091	2.458	2.348	1.55	0.112
Too many weak projects that are approved	2.333	2.061	2.429	2.273	2.417	2.261	1.097	0.363
Inadequate methods and evaluation tools	2.339	2.224	2.449	2.121	2.417	2.304	1.6215	0.091
Link to strategy and strategic criteria not clearly defined	2.246	2.041	2.353	2.121	2.167	2.304	1.094	0.365
Resources are not allocated effectively	2.623	2.449	2.673	2.394	2.583	2.783	1.107	0.354
The flow of information is inadequate	2.355	2.184	2.391	2.333	2.375	2.409	0.416	0.949
Intervals for ranks				1.75-1.999	2.0-2.249	2.25-2.499	2.5-2.749	2.75-3
Colour ranking								

Question 6

There seems to be a difference between top and middle management's rating for the problems identified in this study. What could be the explanation for this?

(Refer to table 7)

Table 60: The means of problems faced by different management levels, using a 1-4 Likert scale

	All N=342	Top Management N=77	Portfolio Management N=45	Programme Management N=62	Project Management N=110	Other N=48	**Current effect (F)**	**P**
Projects lack proper implementation	2.307	2.234	2.244	2.419	2.336	2.271	0.634	0.634
Too many weak projects that are approved	2.333	2.091	2.467	2.565	2.327	2.313	3.025	0.18
Inadequate methods and evaluation tools	2.339	2.195	2.356	2.516	2.409	2.167	1.68	0.154
Link to strategy and strategic criteria not clearly defined	2.246	1.987	2.386	2.371	2.273	2.313	2.337	0.552
Resources are not allocated effectively	2.623	2.364	2.733	2.726	2.682	2.667	2.474	0.044
The flow of information is inadequate	2.355	2.092	2.422	2.516	2.409	2.375	2.651	0.332
Intervals for ranks				1.75-1.999	2.0-2.249	2.25-2.499	2.5-2.749	2.75-3
Colour ranking								

Question 7

The results show that organizations with a portfolio manager rate the problems (identified in this study) lower than those organizations without a portfolio manager. What are the major benefits a portfolio manager can bring to an organization?

Table 61: Comparing the means of problems faced by organizations with and without portfolio managers, using a 1-4 Likert scale

	No portfolio manager (N=102)	**Yes**, there is a portfolio manager (N=236)	**Current effect (F)**	**p**
1. Projects lack proper implementation	2.441	2.25	4.386	0.037
2. Too many weak projects that are approved	2.451	2.275	2.994	0.085
3. Inadequate methods and evaluation tools	2.451	2.288	2.269	0.133
4. Link to strategy and strategic criteria not clearly defined	2.441	2.162	7.131	0.008
5. Resources are not allocated effectively	2.696	2.593	1.061	0.304
6. The flow of information is inadequate	2.515	2.28	5.536	0.019